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Region 2 RAC2
Remedial Action Contract

Final Ecological Screening Evaluation Technical Memorandum, Revision 1

Former Wolff-Alport Chemical Company Site

Remedial Investigation/Feasibility Study

Ridgewood, Queens, New York

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CDM Smith

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Acronyms and Abbreviations

AEC	Atomic Energy Commission
ASI	Aqua Survey Inc.
amsl	above mean sea level
ATV	all-terrain vehicle
BCG	biota concentration guide
bgs	below ground surface
BVNA	Bureau Veritas North America
CDM Smith	CDM Federal Programs Corporation
COPC	Chemical of Potential Concern
CSO	combined sewer overflow
DOE	United States Department of Energy
DPT	direct push technology
EPA	United States Environmental Protection Agency
ESL	Ecological Screening Level
FWACC	Former Wolff-Alport Chemical Company
FS	feasibility study
ft	feet
HHRA	Human Health Risk Assessment
Kd	distribution coefficient
km	kilometer
LBA	Louis Berger and Associates
m	meter
NaI	sodium iodide
NFA	No Further Action Level
NYCDDC	New York City Department of Design and Construction
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NRC	United States Nuclear Regulatory Commission
pCi/g	picocurie per gram
PID	photoionization detector
Ra-226	radium-226
RAC	Remedial Action Contract
RESRAD	RESidual RADioactivity, DOE computer model
RI	remedial investigation
SLERA	Screening Level Ecological Risk Assessment
T&E	threatened and endangered
Th-228	thorium-228
Th-232	thorium-232
TM	Technical Memorandum
U-234	uranium-234
U-235	uranium-235
U-238	uranium-238

USFWS	United States Fish and Wildlife Service
WA	work assignment
%	percent

Section 1
Introduction

CDM Federal Programs Corporation (CDM Smith) received Work Assignment (WA) 054-RICO-A282 under Remedial Action Contract (RAC) 2 to complete a remedial investigation (RI) and feasibility study (FS) for the United States Environmental Protection Agency (EPA), Region 2 for the former Wolff-Alport Chemical Company (FWACC) site (Site) located in Ridgewood, Queens County (also known as the Borough of Queens), New York. The purpose of the RI/FS is to investigate the overall nature and extent of contamination and develop remedial alternatives at the Site. Environmental media investigated during the RI included soil, sediment, groundwater, air and building/sewer construction materials. Samples were chiefly collected to delineate materials contaminated by radioactive waste; however, some samples were also collected for analysis of non-radiological contaminants to determine the presence of non-radiological contamination and to aid in completion of a human health risk assessment (HHRA).

The Site is located in an industrial area with no environmentally sensitive areas (e.g., wetlands) and only limited habitat for most types of ecological receptors; thus, exposure for ecological receptors at the site are unlikely or absent. Due to the extremely limited habitat, a full Screening Level Ecological Risk Assessment (SLERA) was not conducted; instead a focused screening evaluation was conducted and is presented in this Technical Memorandum (TM) in support of the RI. Further, because combined sewer overflow (CSO) discharges at the site may contain thorium waste from monazite sand processing, this evaluation focuses on risks to ecological receptors exposed to property-related CSO discharges as they affect Newtown Creek located approximately 1.9 miles to the northwest. Laboratory analytical results for sediment samples collected from two CSOs as well as from a reference area are used to assess ecological risk from exposure to radionuclides.

The purpose of this document is to describe the likelihood, nature, and extent of adverse effects in ecological receptors exposed to site-related radionuclides due to releases to from past processing activities at the Site to downstream sediments. The results of the analysis, in combination with other RI information, will be used by risk managers to decide whether remedial actions are needed to protect ecological receptors from adverse effects of exposure to site-related contamination.

1.1 Site History

The FWACC site is located at 1125 to 1139 Irving Avenue and 1514 Cooper Avenue in Ridgewood, Queens, New York, at the county border with Brooklyn (**Figure 1-1** and **Figure 1-2**). The site includes these properties as well as properties outside these boundaries where contaminants may have migrated or threaten to migrate. Onsite soils are contaminated with thorium-232 (Th-232) and uranium-238 (U-238), including their decay chain progeny.

The FWACC operated at the property from the 1920s until 1954, importing monazite sand via a rail spur and extracting rare earth metals from the material. Monazite contains approximately 6

percent (%) to 8% or more of thorium. Until 1947, the FWACC disposed of the thorium waste from monazite sand processing in the sewer (process liquors) and possibly by burial on the property (waste tailings). According to the United States Department of Energy (DOE), the Atomic Energy Commission (AEC) ordered FWACC to halt sewer disposal of thorium waste in the fall of 1947. Thereafter, thorium was precipitated as thorium oxalate sludge and sold to the AEC. Documents indicate that FWACC sold approximately 53,000 pounds and 238 drums of thorium oxalate sludge to the AEC from 1948 to 1954, and offered 400 pounds of thorium nitrate for sale to the AEC in 1954. During its years of operation, the FWACC occupied three structures under the address of 1127 Irving Avenue. The operation also included two yard areas: one between the former company's buildings facing Irving Avenue, and the other on the eastern end of the property at the northern end of Moffat Street. These former yard areas, now occupied primarily by structures, were reportedly used as staging areas for monazite sands or waste tailings containing Th-232. The FWACC did not operate out of 1125 Irving Avenue or 1514 Cooper Avenue, but those properties are affected by the radioactive materials at the site.

The nearly triangular subject property affected by contamination, which includes Lots 31 (partial), 33, 42, 44, 46, and 48 of Queens Borough Block 3725, covers approximately 0.75 acre bound by Irving Avenue to the southwest, Cooper Avenue to the northwest, and an active cabinet manufacturer to the east (**Figure 1-2**). At present, the property is covered primarily with contiguous structures, except the former rail spur along its eastern edge, which is an unpaved, vegetated area where tracks are no longer present. The property buildings contain a delicatessen/grocery, office space, residential apartments, tire shop, and former mini-all-terrain vehicle (ATV) shop (1125 Irving Avenue; Lot 46); an auto repair shop and office space (1514 Cooper Avenue; Lot 48); an auto body shop (1127 Irving Avenue; Lot 44); and two warehouses (1129 Irving Avenue; Lot 42 and 1133-1139 Irving Avenue; Lot 33). The former rail spur (portion of Lot 31) is fenced at both ends; and is used for storage of large steel crane equipment.

Radiological surveys by New York City, state, and federal agencies have identified radioactivity above background levels within portions of subject property buildings, in soils beneath and around the FWACC facility and adjacent buildings, and above adjacent sidewalks, streets, and sewers. During an investigation by the New York City Department of Design and Construction (NYCDDC) in 2009-2010, waste tailings consisting of black or gray ash-like material were found in a contaminated soil layer beneath subject property buildings, beneath sidewalks and asphalt surfaces of Irving Avenue and Moffat Street, and within the surface soils of the former rail spur. The depth of visibly contaminated soil at the subject property is typically within the top 1 to 4 feet under the pavement or ground surface; however, a lens of visible contaminated material was observed at 8 to 10 feet beneath the auto body shop.

Th-232 activities[1] up to 1,133 picocuries per gram (pCi/g) were reported for the soil samples containing waste, while Th-232 background was reported to be 0.5 pCi/g to 1.0 pCi/g. Radioactive decay of Th-232, which has a half-life of 14 billion years, proceeds as follows

[1] Activity is used to described the amounts of radionuclides rather than concentration. However, later in the report the term "biota concentrations guides" (BCGs) is used with the same meaning. The latter term is used in the model used to assess risk in this report, and the term is carried over to maintain consistency with this model.

(radioactive half-lives in parentheses): radium-228 (5.8 years), actinium-228 (6.1 hours), thorium-228 (1.9 years), radium-224 (3.7 days), radon-220 (56 seconds)[2], polonium-216 (0.15 second), lead-212 (11 hours), bismuth-212 (61 minutes), polonium-212 (310 nanoseconds), thallium-208 (3.1 minutes), and lead-208 (stable). Due to the length of time since processing of the monazite sands began (about 60 years or more), it is reasonable to assume secular equilibrium (i.e., the activities of all radionuclides within the series are nearly equal) for these radionuclides in the waste materials abandoned at the site.

To address human health risks associated with exposure to ionizing radiation, in 2013, the EPA installed a combination of lead, steel and concrete shielding within several on-Site buildings and along a portion of the Irving Avenue sidewalk adjacent to the Site, and a radon mitigation system was installed in one building. The former rail spur behind the on-Site buildings was also covered with a layer of rock and clean fill in order to reduce exposure to waste material. Subsequent radiation surveys conducted by the EPA found that the shielding successfully reduced exposure rates by between 69 to 94%, while radon activities decreased by more than half. The Site was added to the National Priorities List on May 12, 2014.

Recent investigations have indicated that residual contamination still exists in or around the sewer lines downstream of the facility. During periods of heavy flow such as rainstorms, CSOs discharge from this combined sewer system to Newtown Creek west of the subject property. In 2013, Bureau Veritas North America (BVNA) performed an investigation on behalf of the New York City Department of Environmental Protection (NYCDEP) to assess current impact to sewers in the vicinity and downgradient of the FWACC property. Results of soil borings found no contaminated soils along the sewer lines with the exception of those adjacent to the FWACC property. However, surveys in sewers did detect radiological constituents above background activities at least as far downgradient as the intersection of Irving Avenue and Halsey Street (approximately 0.25 mile from the FWACC).

1.2 Report Organization

The following sections are presented in this TM:

1. Section 1 Introduction
2. Section 2 Problem Formulation
3. Section 3 Screening Methodology
4. Section 4 Screening Evaluation
5. Section 5 Summary
6. Section 6 References

[2] Rn-220 is also known as thoron to distinguish it from Rn-222 to which most discussions of radon refer. Rn-222 is a progeny of radium-226.

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Section 2
Problem Formulation

This evaluation is an abbreviated SLERA and includes a streamlined problem formulation. Problem formulation is a planning and scoping process that establishes goals, breath, and focus of the risk assessment. Its end-product is a conceptual model that identifies environmental values to be protected (the assessment endpoints), exposure and effects, data needed, and the analysis to be used.

Site-related environmental stressors, the ecosystems in which the stressor may occur, as well as the biota that may be exposed were identified in the Work Plan (CDM Smith 2014) and are described in the following sections. This section describes the local setting, available habitats, and natural communities at or bordering the FWACC site and at the reference area. Due to extremely limited habitat an ecological survey was not performed.

2.1 Environmental Setting

The neighborhood around the Site consists of light industry, commercial businesses, and residences (**Figure 1-1**). The site is bound by Irving Avenue to the southwest, Cooper Avenue to the northwest, and an active cabinet manufacturer to the east. An active rail line passes within 125 feet of the site. The Cemetery of the Evergreens is across the rail line to the southeast of the site. Nearby residential areas are densely populated containing multifamily homes. The end of Newtown Creek is located approximately 1.9 miles northwest of the FWACC site and is the location where sewer lines from the site reportedly discharge.

The following sections present a summary of the FWACC environmental setting and current conditions.

2.1.1 Regional and Local Setting

2.1.1.1 Topography

The FWACC site is located in the Atlantic Coastal Plain Physiographic Province which is characterized by generally flat terrain separated by low rolling hills of modest relief. The topography of the FWACC site slopes gently west-southwest with elevations ranging from approximately 75 to 65 feet above mean sea level (amsl).

2.1.1.2 Geology

The sediments underlying the FWACC site are commonly referred to as Upper Pleistocene deposits, which are terminal moraine and glacial outwash in origin. Based on numerous investigations at the site, upper soil layers are mostly fill material, composed of silt to sandy gravel with varying amounts of concrete, brick, and asphalt underlain primarily by sand, with varying amounts of silt and gravel.

2.1.1.3 Hydrogeology

The groundwater table is approximately 50-60 feet below ground surface (bgs), based on measurements taken in 2015. Groundwater is anticipated to generally flow south from the site eventually discharging to Jamaica Bay. The site lies near a groundwater divide and historic pumping for industrial uses had previously influenced groundwater flow, resulting in a westerly to northwesterly flow direction in the vicinity of the site (Louis Berger and Associates, 2010).

2.1.2 Natural Communities

2.1.2.1 Terrestrial Habitat

The FWACC site is a highly industrialized area. The majority of the site is covered by buildings, cement, and pavement. The small open area of the former rail spur behind the on-Site buildings consists of disturbed soil covered with a layer of rock and clean fill.

Only animals (e.g., rodents, raccoons, bats, birds) capable of surviving in an urban habitat might be found in the area. However, mammals were not observed during the RI sampling events.

2.1.2.2 Aquatic and Wetland Communities

The FWACC site is 1.9 miles from the East Branch of Newtown Creek. Newtown Creek and adjacent ecosystems are part of the Newtown Creek Superfund Site. Newtown Creek is a tidal arm of the New York-New Jersey Harbor Estuary that forms the northern border of the borough of Brooklyn and the southern border of the borough of Queens in New York City. Newtown Creek includes the tributaries of Dutch Kills, Maspeth Creek, Whale Creek, East Branch, and English Kills. The entire Creek system is approximately 3.8 miles in length and discharges to the East River near Hunter's Point and Roosevelt Island.

Historically, Newtown Creek drained the uplands of western Long Island and flowed through wetlands and marshes. However, due to heavy industrial development and governmental activities dating from the 1800's, formerly wet areas have been filled, Newtown Creek has been channelized, and its banks have been stabilized with bulkheads and rip rap. The historic development has resulted in dramatic changes in Newtown Creek from a natural drainage condition to one that is governed largely by engineered and institutional systems.

Newtown Creek flows through a highly industrialized area, is estuarine, and experiences tidal fluctuations of approximately two to six feet (NYCDEP 2011). Newtown Creek is one of the nation's most polluted waterways because of its industrial history, including countless spills and illegal dumping. Currently, factories, warehouse and distribution facilities, petroleum bulk storage facilities, municipal and utility infrastructure and other industrial and commercial facilities still operate along the Creek. Newtown Creek is classified by the New York State Department of Environmental Conservation (NYSDEC) as Class SD saline water, a NYSDEC classification that indicates the best use of this Creek is fishing and that the waters should be suitable for fish survival. However, since 2004, Newtown Creek has been listed on the EPA Clean Water Act 303(d) list as impaired due to oxygen depletion.

The freshwater contribution to flow in Newtown Creek is primarily from groundwater, storm water, combined sewer overflows, and wastewater discharges. Stream velocity ranges from 0.4 feet/sec to 1.2 feet/sec (NYCDEP 2007). A 2004 SF6 (sulfur hexafluoride) tracer study indicated

that chemical contaminants in Newtown Creek surface water had travelled over 9 miles, to the Verrazano Bridge, within one day of release into the Creek (Schmieder et al. 2004).

2.2 Chemicals of Potential Concern, Transport, and Fate

Environmental media investigated during the RI included soil, sediment, groundwater, air and building/sewer construction materials. For this analysis only sediment radionuclide data are used. Sediment samples were collected in the East Branch of Newton Creek and in Coney Island Creek (over 5 miles to the southwest), which is used as a reference area.

2.2.1 Chemicals of Potential Concern

Onsite soils are contaminated with Th-232 and U-238, including their decay chain progeny. This evaluation identifies these radionuclides as chemicals of potential ecological concern (COPECs) and specifically evaluates ecological exposures to thorium-228 (Th-228), thorium-230 (Th-230), radium-226 (Ra-226), Th-232, uranium-234 (U-234), uranium-235 (U-235), and U-238 in sediment.

2.2.2 Fate and Transport

Until 1947, the FWACC disposed of the thorium waste from monazite sand processing in the sewer (process liquors) and possibly by burial on the property (waste tailings). Primary transport mechanisms from release from the FWACC site to Newtown Creek sediments may have included: overland runoff and sedimentation, surface water transport, groundwater discharge, food web, and airborne transport and atmospheric fallout of particulates. Of these mechanisms, current exposure for ecological receptors to site-related hazardous substances are likely a result of (1) historic discharges to the sewer system which may have impacted a localized area of the East Branch of Newtown Creek, (2) movement of contaminated sediment in Newtown Creek, and food web transport within the aquatic community in the Creek. Transport of contaminants via the food web is frequently a significant transport mechanism. Risks to higher trophic level receptors via food web ingestion of food items are important because these receptors have greater potential to be exposed to chemicals that bioaccumulate and in some cases biomagnify.

2.3 Conceptual Site Mode, Exposure Pathways and Receptors

Natural resources in Newtown Creek are affected by adverse conditions in the Creek caused by the combination of hazardous substances; excess nutrients (and associated anoxic conditions); wastewater discharges; combined sewer overflows; and physical changes to the habitat, including dredging, channelization, and shoreline hardening. Anoxic conditions frequently occur and Newtown Creek has been included on the Clean Water Act 303(d) list since 2004 as impaired due to oxygen depletion. The shoreline of the Creek is substantially hardened with riprap and bulkheading and there is little adjacent terrestrial habitat in this urbanized environment. The adverse environmental conditions in Newtown Creek are not a result of contaminant transport from the Site. However, radionuclides have been detected at activities above those detected in the reference area in a localized area surrounding outfall NCB-083CSO in the East Branch of Newtown Creek. The source of radionuclides in sediment at NCB-083CSO cannot be determined with certainty based on the available data and the multiple sources contributing to contamination of Newtown Creek.

2.3.1 Aquatic Receptors

The following information was obtained from investigations conducted for the Newtown Creek Superfund Site. As previously noted the Newtown Creek is 3.8 miles in length and the receptors described below may be more applicable for conditions at some distance from the FWACC site.

Currently, water and sediment quality conditions preclude the diversity and abundance of fish and wildlife resources that would normally be expected in an urban estuarine habitat of this type. This is evidenced by the lack of species present in Newtown Creek that are found in the adjacent East River, which provides similar estuarine habitat (United States Department of the Interior 2012). However, the ecological receptors found in Newtown Creek are also typically supported in the aquatic ecosystem found in the East River.

Fish

Post larval stage fish found in Newtown Creek in the 2007 NYCDEP survey (NYCDEP 2011) were striped bass (*Morone saxatilis*), weakfish (*Cynoscion regalis*), and winter flounder (*Pleuronectes americanus*). Ichthyoplankton, in particular larval fish, included additional species such as American sand lance (*Ammodytes americanus*) and gobies. Few fish eggs were found in the NYCDEP survey, except at the mouth of Newtown Creek, suggesting limited fish spawning within the Creek (NYCDEP 2011). A more diverse fishery exists in the adjacent East River; these include bluefish (*Pomatomus saltatrix*), Atlantic silverside (*Menidia menidia*), Atlantic menhaden (*Brevoortia tyrannus*), scup (*Stenotomus chrysops*), fourbeard rockling (*Enchelyopus cimbrius*), bay anchovy (*Anchoa mitchilli*), silver hake (*Merluccius bilinearis*), grubby (*Myoxocephalus aeneus)*, Atlantic tomcod (*Microgadus tomcod*), tautog (*Tautoga onitis*), blueback herring (*Alosa aestivalis*), northern pipefish (*Syngnathus fucus*), summer flounder (*Paralichthys dentatus*), northern searobin (*Prionotus carolinus*), and white perch (*Morone americana*).

The shortnose sturgeon (*Acipenser brevirostrum*) is Federally listed as an endangered species in Queens and Bronx counties (United States Fish and Wildlife Service [USFWS] 2010), and has been extensively studied in the Hudson River (DTA 2004). It may occasionally pass through the East River, although the East River is not considered as suitable habitat for this species (Bain 2009).

Benthic Invertebrates

The sampling performed thus far in Newtown Creek revealed a limited number and diversity of benthic invertebrates, most of which were annelid worms and other pollution-tolerant organisms (NYCDEP 2011). The benthic community of the East River was evaluated as part of a license application for the Ravenswood Generating Station. The Ravenswood Generating Station is located on the East River, approximately two miles north of where Newtown Creek discharges to the East River. The Ravenswood benthic community was more diverse than the Newtown Creek benthic community and included sand worms (*Alitta virens*), tunicates (*Tunicata*), clams, mudworms (*Polydora ligni*), polychaetes, nematodes, amphipods, oligochaetes, rock crabs (*Cancer irroratus*), lady crabs (*Ovalipes oscellatus*), horseshoe crabs (Limulus polyphemus), mud crabs (*Panopeus herbstii*), spider crabs (*Libinia emarginata*), blue crabs (*Callinectes sapidus*), shrimp, grass shrimp (*Palaemonetes pugio*), blue mussels (*Mytilus edulis*), and dog whelks (*Nucella lapillus*) (TRC Environmental 2000). Benthic macroinvertebrates found in earlier biota surveys from the East River (1980s) are consistent with the assemblage of benthic invertebrates

reported at Ravenswood (DTA 2004). Some of these taxa, and potentially others, such as Eastern oyster, may be expected to occur in Newtown Creek if water and sediment quality improved.

Amphibians and Reptiles

Amphibians and reptile species may occur in the in the vicinity of Newtown Creek and the East River. However, in the various ecological surveys that have been conducted around Newtown Creek, reptiles and amphibian species have not been observed.

Birds

In spite of impaired aquatic habitat and limited physical habitat, double-crested cormorants (*Phalacrorax auritus*), belted kingfishers (*Magaceryle alcyon*), black-crowned night-herons (*Nycticorax nycticorax*), barn swallows (*Hirundo rustica*), laughing gulls (*Larus atricilla*), peregrine falcons (*Falco peregrinus*) and great egrets (*Ardea sp.*) have been reported along Newtown Creek (Anchor 2011). With improved sediment and water quality, and enhancement of terrestrial and riparian habitat along Newtown Creek, this area is expected to support birds typically found in the lower Hudson River or East River, species such as mallard (*Anas platyrhynchos*), canvasback (*Aythya valisineria*), scaup (*Aythya* spp.), and Canada goose (*Branta canadensis*). The piping plover (*Charadrius melodus*) is a Federally listed endangered species in Queens County that may occur rarely in the vicinity of Newtown Creek (USFWS 2010).

Mammals

Mammals that may be adversely affected by direct or food web exposures and habitat degradation in the vicinity of Newtown Creek are those capable of surviving in an urban environment. These mammals include raccoons, skunks, rabbits, muskrats, bats and a variety of rodents. Marine mammals that could be impacted include harbor seals and harbor porpoises.

Threatened and Endangered Species

Federally- or State-listed species that may occur in the East River, and potentially Newtown Creek, include the shortnose sturgeon, sea turtles, including the Kemp's ridley sea turtle (*Lepidochelys kempii*), loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricata*), green sea turtle (*Chelonia mydas*), and piping plover (*Charadrius melodus*).

2.3.2 Exposure Pathways

Pathways by which receptors may be exposed to radionuclides from the FWACC include surface water transport, possible groundwater discharge, overland runoff and sedimentation, food web (dietary pathway), and airborne transport and atmospheric fallout of particulates. Of these, the most probable route of site-related radionuclide transport results from historic discharges of waste to the sewer and subsequent transport to Newtown Creek and movement of contaminated sediment within the food web. Other pathways that may have been complete in the past such as airborne transport have been eliminated through removal actions and placement of barriers (e.g., rock layers and soil covers).

Exposure pathways that could contribute to an external dose to biota include radionuclides in water, soil, and sediment. Pathways that could contribute to an internal dose in animals include ingestion of radionuclides in water, vegetation, sediment and soil, and inhalation of contaminated

air and soil particles. However, active air (i.e., continuous air emission) releases were not included in the derivation of screening values because biota inhalation and immersion in air were estimated to be relatively insignificant contribution contributors to exposure. Unlike release of radionuclides to water or soil, atmospheric discharge almost always rapidly disperses. Inhalation exposure is typically not quantitatively evaluated for ecological receptors.

Exposure pathways evaluated in this analysis for animal receptors in the aquatic ecosystem, including riparian species, include: ingestion of radionuclides in water, in soil/sediment, and in food sources. A site conceptual exposure model is presented in **Figure 2-1**.

2.4 Sediment Data

Data used in this analysis consists of analytical results from sediment samples collected from five locations at each of the two CSOs in Newtown Creek and from ten locations in Coney Island Creek, which is used as a reference location. These sediment data are used to evaluate exposure to biota in aquatic and riparian habitats through comparison with screening criteria described in Section 3. Screening criteria selected are based on the limiting organism in the aquatic ecosystem, i.e. the lowest screening level among all species evaluated. As discussed in Section 3 for this analysis the limiting organism was a riparian animal (i.e., racoon).

2.4.1 Newtown Creek (East Branch)

Sediment samples were collected in the East Branch of Newtown Creek to determine if radioactive material historically disposed in the sewers at the site has discharged to and impacted sediment in Newtown Creek. The sewer line originating at the site discharges to Newtown Creek at outfall NCB-083. Newtown Creek-East Branch sediment core locations include EB-01 through EB-08 (**Figure 2-2**). A pontoon-boat mounted vibracore unit, operated by Aqua Survey Inc. (ASI), was used to collect sediment samples from the eight locations in a roughly pyramid-shaped pattern at the NCB-083 discharge point extending to approximately 60 feet from the shoreline. A ten-foot long, 4-inch diameter, steel barrel attached to a vibracore head was used to collect the sediment cores at each location. The steel barrel and core catcher were rinsed with creek water and a new, plastic core liner was placed inside the barrel prior to collecting each core. Following extraction of the core from the core barrel, creek sediment cores were scanned with an uncollimated 2x2 inch sodium iodide (NaI) detector (Ludlum 44-10 probe/2221 meter). The lithology of each core was logged by the geologist and the soils were screened for the presence of organic vapors using a photoionization detector (PID). Samples for gamma spectroscopy, isotopic uranium, and isotopic thorium analysis were collected in one foot intervals (i.e. 0-1 feet [ft], 1-2 ft, 2-3 ft, etc.) and homogenized.

Summary statistics for radionuclides detected in surface sediment (0 to 2 feet) samples are presented in **Table 2-1.** The total number of samples does not include field duplicates or any data that was rejected during the data validation process. Only a few of the gamma spectroscopy results for radium-226 were rejected and are not included in the summary tables (see Section 2.5). Except for U-235, most radionuclides were detected in 100 percent of surface sediment samples. Activities of Th-232 in surface sediment samples collected from 0 to 2 feet ranged from 0.198 pCi/g to 9.595 pCi/g. Maximum activities of Th-230 and Th-232 were observed in the 1 to 2-foot interval. Summary statistics for radionuclides grouped for all depth intervals are presented

in **Table 2-2.** Results for all sediment samples are presented in **Appendix A;** isotopic results are shown in Table A-1 and gamma spectroscopy results are shown in Table A-2.

2.4.2 Coney Island Creek

Sediment samples were collected in Coney Island Creek to establish background sediment data (**Figure 2-3**). Two 10-foot sediment cores, CIC-01 and CIC-02, were collected following the same procedure as the sediment cores in Newtown Creek.

Eight one-foot grab samples were also collected using a ponar-type grab sampler. The grab sample locations include CIC-03 through CIC-08. Samples were scanned with an uncollimated 2x2 inch NaI detector (Ludlum 44-10 probe/2221 meter). The lithology of each core was logged by the geologist and the soils were screened for the presence of organic vapors using a PID. Samples for gamma spectroscopy, isotopic uranium, and isotopic thorium analysis were collected in 0.5 foot intervals (i.e. 0-0.5 and 0.5-1 ft.) and homogenized.

Summary statistics for radionuclides in reference surface sediment samples (0 to 2 feet) are presented in **Table 2-1.** All of the radionuclides were detected in 100 percent of the surface sediment samples except for U-235. Activities of Th-232 in surface sediment samples ranged from 0.23 pCi/g to 0.612 pCi/g. Summary statistics for radionuclides grouped by depth interval are presented in **Table 2-2.** Results for all sediment samples are presented in **Appendix A**.

2.5 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were conducted according to the Quality Assurance Project Plan (QAPP) (CDM Smith 2015). QA/QC samples collected in the field for all media consisted of field duplicates collected at a rate of 10 percent. All data used in this evaluation were evaluated according to the criteria specified in the QAPP. Data usability is discussed in detail in the Data Usability Report (CDM Smith 2016). The data usability assessment found that over 90 percent of the data reported and validated are suitable for their intended purpose (i.e., use in the RI/FS and the risk assessment).

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Section 3
Screening Methodology

This section describes the methodology used to evaluate exposure for ecological receptors to site-related radionuclides that may be present in sediment in the East Branch of Newtown Creek from historic transport through the sewer.

3.1 Screening Criteria

The RESidual RADioactive (RESRAD) Biota Code (Version 1.5, November 11, 2009) developed by the Environmental Science Division of Argonne National Laboratory for DOE with support from EPA and United States Nuclear Regulatory Commission (NRC) was used to develop biota concentration guides (BCG) for receptors in the aquatic ecosystem (Argonne 2001). These values were used for some of the radionuclides of concern for the FWACC site. The same methodology was used to determine BCGs for additional radionuclides of concern.

BCGs were derived using the radionuclide exposure model of Blaylock et al. (Blaylock, Frank, and O'Neal 1993). BCGs are generic screening values intended to be protective for various receptors and include internal and external exposure from all major alpha, beta, and gamma emissions for each isotope. For aquatic and riparian animals exposed to sediment the area factor was set at 1 and the dose limit was 0.1 rad/day. Based on the results of the dose estimates, the limiting organism for exposure to radionuclides in sediment was the riparian animal[3]. Exposure assumptions (e.g. food source, ingestion rate, body weight) for receptors are based on default values in the RESRAD-Biota model for the media of concern being evaluated.

Each radionuclide-specific BCG represents the limiting radionuclide concentration in an environmental medium which would not result in an exceedance of the 0.1 rad/day threshold. BCGs are considered No Further Action levels for limiting organism(s) in the aquatic ecosystem, which includes riparian receptors.

3.1.1 RESRAD-BIOTA Model

The RESRAD-BIOTA model is designed to perform DOE's graded approach for evaluating ionizing radiation doses to populations of aquatic and terrestrial biota, which may consist of a three-step process starting with a conservative general screening to, if needed, a rigorous analysis using site-specific information (DOE 2002). The three step process includes: (1) assembling radionuclide activity data and knowledge of sources, receptors, and routes of exposure for the area to be evaluated, (2) applying a general screening methodology, that provides limiting radionuclide activity values (i.e. BCGs in soil, sediment, and water), and (3) if needed conducting an analysis through site-specific screening, site-specific analysis, or an actual site-specific biota dose assessment (DOE 2004). This evaluation is a level 2 analysis where BCGs were determined for the limiting organism (riparian animal) in the aquatic ecosystem. This receptor is anticipated to have higher exposure to radionuclides in sediment than other receptors (riparian plants and

[3] The designation is not specific to a taxonomic group and considers sensitivities across a variety of species common to riparian habitats.

aquatic plants and animals). Possible exposures experienced by these animals were compared to BCG for the suite of radionuclides identified as COPC for FWACC.

Internal and external sources of dose (and their contributing exposure pathways) are incorporated in the derivation of the graded approach methodology. Sufficient prudence has been exercised in developing each assumption and default parameter value to ensure that the resulting BCGs are appropriately conservative. In the event that an individual default parameter value is subsequently found to be an upper-end value but not the "most-limiting" value for a unique site-specific exposure scenario, the other assumptions and default parameter values ensure that the BCGs (and resultant doses to biota) still provide the appropriate degree of conservatism for screening purposes.

Existing effects data support the application of BCGs to representative individuals within the population of plants and animals. Assumptions and parameters applied in deriving the BCGs are based on maximally exposed individual organisms, rather than on population-level effects. Screening using BCGs is thus an appropriate, conservative approach for the SLERA.

Exposure assumptions for receptors are based on the values for the default representative receptor in the RESRAD-Biota model for the media of concern being evaluated. Default receptors provided in the RESRAD-Biota model were selected so that (1) they are important to the structure and function of the community, (2) are expected to receive a radiation dose to reproductive tissues which is relatively high per unit of radionuclide present in the ecosystem, in comparison with other receptors in the same community, and (3) have a comparatively high degree of radiosensitivity (e.g., radiation effects of concern occur at relatively low doses, in comparison with other receptors in the same community). Among animals, mammals are the most sensitive animals, followed by birds, fish, amphibians, reptiles, crustaceans, insects, and mollusks, although there is considerable overlap in the range of sensitivities (Rose 1992: Eisler 1994; UNSCEAR 1996).

The contribution to dose from external radioactive material was estimated assuming that all of the ionizing radiation was deposited in the organism (i.e., no pass-through and no self-shielding). This is conservative and is tantamount to assuming that radiosensitive tissues of concern (e.g., the reproductive tissues) lie on the surface of a very small organism. For external exposure to contaminated soil, the source is presumed to be infinite in extent. In the case of external exposure to contaminated sediment and water, the source was presumed to be semi-infinite in extent. The source medium to which the organisms are continuously exposed is assumed to contain uniform activities of radionuclides. These assumptions provide for appropriately conservative estimates of energy deposition in the organism from external sources of radiation exposure. For this analysis only measured sediment radionuclide activities were entered; activities of radionuclides in soil and water entered into the model were zero. If only a sediment activity is entered into the model, a conservative sediment distribution coefficient (Kd) can be used in the model to calculate the corresponding surface water concentration; however, for this analysis the surface water concentration was assumed to be zero. Media of concern evaluated for site related impacts was sediment; surface water samples were not collected. Although contaminants in sediment may be released to surface water through various processes these transfer processes would likely result in contaminants being transported away from the area evaluated and diluted by creek flow.

The contribution to dose from internal radioactivity was conservatively estimated assuming that all of the decay energy is retained in the tissue of the organisms (i.e., 100 percent absorption). Progeny of radionuclides and their decay chains are also included. This approach overestimates internal exposure, as the lifetimes of many of the biota of interest are generally short compared to the time for the build-up of progeny for certain radionuclides. RESRAD-Biota incorporates a maximum lifespan for the default receptor evaluated in the intake rate calculation. Radionuclides are presumed to be homogeneously distributed in the tissues of the receptor organism. Such distribution is unlikely to underestimate the actual dose to the tissues of concern (i.e., reproductive organs). A radiation weighing factor of 20 for alpha particles is used to calculate BCGs for all organism types. This approach is conservative, especially if non-stochastic effects are most important in determining harm to biota.

The limiting concentration in sediment was calculated by first setting a dose limit for aquatic organisms of 1 rad per day and riparian animals of 0.1 rad per day and then back-calculating to the medium concentration (i.e., the BCG) necessary to produce the applicable internal and external doses from radionuclides in the environment. The ratio of the concentration in sediment to the BCG is calculated. Ratios equivalent to 1 or less than 1 indicate that adverse effects from exposure to radionuclides would be below a population-level effect. High ratios may indicate effects on aquatic/riparian communities.

Note that no guidelines are available for radiological effects to individual species – BCGs are appropriate for a community of riparian animals. This lack of information precludes the direct evaluation of impacts to threatened and endangered species. However, threatened and endangered species have not been observed in the area of Newtown Creek evaluated in this analysis. Moreover, the conservative derivation of BCGs is likely to be protective for most species regardless of threatened and endangered (T&E) status.

The general dose equation and approach to derive BCGs is given by (DOE 2002, page M3-24):

$$BCG = \frac{Dose_{limit}}{AF \times (UF \times DCF_{int} + DCF_{ext})}$$

where:

BCG = Biota concentration guideline (pCi/g) soil sediment, or (pCi/L) water

$Dose_{limit}$ = Acceptable dose (0.1 rad/day riparian animals; 1 rad/day aquatic animals and terrestrial plants)

DCF_{int} = Dose conversion factor for internal radiation (rad/day)/pCi/g)

DCF_{ext} = Dose conversion factor for external radiation (rad/day)/pCi/g) for soil/sediment or (rad/day)/pCi/L) for water

UF = Media to biota empirical uptake factor (pCi/g-biota)/(pCi/g-media) for soil/sediment, or (pCi/g-biota)/(pCi/L-media) for water – accounts for dietary uptake

AF = Area correction factor to account for biota habitat/foraging area and residence time (default set to 1 for screening level BCGs).

In the RESRAD-BIOTA model general composite benchmarks use lumped factors (concentration factors) that predict tissue concentrations based on concentrations of radionuclides in environmental media. Initial values of lumped parameters were specifically chosen to produce conservative (e.g., highly protective) BCGs. It is recognized that actual lumped parameters for a single radionuclide may range over several orders of magnitude, depending upon biotic and abiotic features in the environment. The user has the option to change the target dose and the area correction factor. For this analysis the dose limit was set to 0.1 rad per day for riparian animals. The default area factor of 1 was used which means that receptors were assumed to be resident in the contaminated area (e.g., exposed to contaminated media) 100 percent of the time.

External dose exposure pathways for riparian animals include: exposure to radionuclides in sediment and exposure to radionuclides in water. Internal dose exposure pathways include: exposure to radionuclides via ingestion of contaminated food source, including water content with dissolved nutrients and minerals, and exposure to radionuclides biomagnified through the food web. Four basic tiers for default receptors are included: primary producers, macroinvertebrates, forage fish, and larger predators. RESRAD-biota uses a radionuclide-specific food source parameter in calculating the internal dose contribution for riparian animals. The default food source for the riparian animal is an aquatic animal (e.g. fish). As noted previously. the concentration of radionuclides in water used in this analysis was 0.

Results for BCGs are shown in the reports generated by the RESRAD-BIOTA program (DOE 2009) for aquatic biota (i.e., aquatic animal and riparian animal) presented in **Appendix B**. These BCGs for the protection of biota do not differentiate between radionuclides originating from anthropogenic and natural sources. That is, the risk assessment is not designed to address source allocation.

3.1.1.1 Biota Concentration Guides for Radionuclides of Concern

Table 3-1 presents the BCGs (no further action levels) for riparian animals exposed to radionuclides in sediment in the aquatic environment. These BCGs are used to screen the total radiological dose to population of generic (not species specific) riparian animals based on maximum and mean activities of radionuclides of concern reported in sediment samples collected from the East Branch of Newtown Creek. As recommended in RESRAD-Biota guidance (DOE 2009) the maximum concentration is used as conservative initial screening comparison value and if data are sufficient the mean concentration can be used.

Section 4
Screening Evaluation

The BCGs used in this analysis are based on the current state of science and knowledge regarding effects of ionizing radiation on plants and animals. They should not be interpreted as a "bright line" that if exceeded, would trigger a mandatory regulatory or remedial action. Rather, they should be interpreted and applied as guidelines that provide an indication if populations of plants and animals could be adversely affected by exposure to ionizing radiation. This information may help inform risk managers concerning the need for further investigation and/or action.

Certain taxa are more sensitive to ionizing radiation than others. Based on this observation, it is generally assumed that by protecting the more sensitive taxa other, less sensitive taxa will be protected. This premise forms the basis for the Tier 2 evaluation presented in this report.

4.1 Comparison to Biota Concentration Guides

Maximum radionuclide activities detected in sediment samples were initially compared to BCGs to provide the most conservative evaluation. **Table 4-1** presents the results of screening comparison for surface and subsurface sediment samples. As recommended in the RESRAD-Biota guidance (DOE 2009) mean radionuclide activities were also compared to BCGs to provide an indication of more typical exposure (e.g. random exposure within an area). Mean activities also provide a general indication of spatial variability in the distribution of contamination. As seen, neither maximum or mean activities of radionuclides reported in sediment exceeded their respective BCG. A screening comparison grouped by individual depth intervals is shown in **Table 4-2**.

Because a receptor may be exposed to more than one radionuclide in a medium or across media, a sum of fractions approach is used to compare measured radionuclide activities in environmental media with BCGs. That is, when multiple radionuclides are present, the sum of fractions of the measured activities of each radionuclide to its corresponding BCG is summed. For this analysis, the sum of all fractions for each radionuclide in sediment is calculated. If the sum of fractions is less than 1 the dose to an aquatic ecosystem receptor is below the biota dose limit, indicating unacceptable risk is unlikely. For example, if the ratios of activity to BCG are 0.0008 and 0.0039 for Th-232 and Ra-228, the sum of these fractions, 0.0047, would represent exposure to radiation from these two isotopes (**Table 4-1**).

As shown in **Table 4-1**, using maximum activities the sum of fractions is significantly below 1, indicating that the limiting receptor for the aquatic ecosystem (i.e., riparian animal) will not be exposed to unacceptable risk.

Radiation doses at the local background reference site (i.e., Coney Island Creek) were assessed to evaluate if site-related dose rates represent an actual increase in exposure. Based on average activities in surface sediment, exposure to Th-228 and Th-232 was approximately 15 times higher for the East Branch of Newton Creek receptor compared to the reference receptor. Exposure to Th-230 was approximately 2 times higher for the East Branch of Newton Creek

receptor compared to the reference receptor. Exposure to U-234, U-235, and U-238 were slightly higher for the reference receptor than the site receptor. Average isotopic results for radionuclides in surface sediment for the East Branch of Newtown Creek and Coney Island Creek are shown on **Figure 4-1** for comparison purposes. Although activities of thorium isotopes in East Branch of Newton Creek were above those detected in the reference area, none of the activities of radionuclides were reported at levels above their respective BCGs.

4.1.1 Summary of Screening Results

The results of the assessment using RESRAD-BIOTA BCGs indicate that dose rates to riparian animals are below those rates that may cause a population-level effect. The studies resulting in the 0.1 rad per day criterion for riparian animals are based on exposures to organisms for 1 year, and then normalized to a dose rate based on a day. One could interpret these results to mean that a dose rate of 0.1 rad per day, if sustained for a year, may have an effect on some individuals but not on the population as a whole. No guidelines are available for radiological effects to individuals, which is important in evaluating impacts to threatened and endangered species. As noted previously, threatened and endangered species were not observed in the area being evaluated, and BCGs are likely to be protective for most species regardless of T&E status.

Section 5
Summary

This screening level evaluation for ecological receptors followed the methodology outlined in the RI/FS Work Plan (CDM Smith, 2014) which is consistent with DOE (2002) guidance. In the data assembly phase, the area to be evaluated was determined, receptors were identified, and exposure pathways were considered. The DOE RESRAD-BIOTA model was used to estimate sediment BCGs for riparian receptors. BCGs were compared to radionuclide data collected from the East Branch of Newtown Creek and a reference area (i.e., Coney Island Creek) to determine the potential for adverse effects to ecological receptors from exposure to site-related ionizing radiation.

5.1 Summary of the Screening Level Evaluation

The Site is located in an industrial area with no environmentally sensitive areas (e.g., wetlands) and very limited habitats for ecological receptors; thus, exposures for ecological receptors at the site are unlikely. Due to the extremely limited habitat, a full SLERA was not conducted; instead a focused screening evaluation was conducted. The FWACC site is 1.9 miles from the East Branch of Newtown Creek. Newtown Creek and adjacent ecosystems are part of the Newtown Creek Superfund Site.

Newtown Creek is one of the nation's most polluted waterways as a result of its industrial history, including countless spills and illegal dumping. Industrial uses along Newtown Creek have included oil refineries, petrochemical plants, copper smelter, fertilizer and glue factories, sawmills, and lumber and coal yards. Currently, factories, warehouse and distribution facilities, petroleum bulk storage facilities, municipal and utility infrastructure and other industrial and commercial facilities still operate along the Creek. Various contaminated sites along the Creek have contributed to the contamination at Newtown Creek and a Remedial Investigation is currently being conducted for Newton Creek.

Sewer overflows may have contained thorium waste from past monazite sand processing which were subsequently discharged to Newtown Creek. The area under evaluation is the mostly likely area where ecological receptors could be exposed to site-related impacts. Therefore, this evaluation focuses on risks to ecological receptors exposed to the site-related CSO discharges to Newtown Creek. The media of concern is sediment.

Receptors that could be exposed to radionuclides in the aquatic ecosystem include aquatic and riparian vegetation, aquatic animals, riparian animals, and other animals that use aquatic resources. It was determined that the generic riparian animal was the limiting organism for the sediment exposure pathway. External dose exposure pathways for riparian animals include: external exposure to radionuclides in sediment and water. Internal dose exposure pathways include: exposure to radionuclides via ingestion of contaminated food sources (e.g., aquatic animals), ingestion of water, ingestion of sediment, and exposure to radionuclides biomagnified through the food web.

The RESRAD-BIOTA model was used to estimate sediment BCGs for riparian receptors. Each radionuclide-specific BCG represents the limiting radionuclide concentration in an environmental medium which would not result in recommended dose standards for biota to be exceeded. BCGs define doses below which risks to populations are assumed not to occur. This definition simplifies those steps conducted in a typical ecological risk assessment that involve assessing the relationship between stressor levels and ecological effect, characterizing, estimating, and assessing risks. Comparison of site activities to BCGs essentially characterizes risks for the population of concern. If warranted, a more intensive analysis can be conducted using the RERASD-BIOTA taking into consideration more site information and site specific receptor information. For the FWACC site, this screening level evaluation is adequate because radionuclide activities are significantly below BCGs. Further supporting conclusions of low or insignificant risk to ecological receptors are observations that the site and nearby areas provide only limited ecological habitat.

Maximum and mean radionuclide activities measured in sediment were compared to BCGs for riparian animals that use the aquatic ecosystem. The results of the screening evaluation verify that radionuclide activities in sediment in the East Branch of Newtown Creek are less than BCGs and that doses to receptors are below threshold limits. Measured radioactivity for many isotopes in sediment is likely due to natural background with the notable exception of the thorium (i.e. Th-228, Th-230, and Th-232) and their progeny. Activities reported for Th isotopes are above activities considered to represent local background.

Section 6
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Tables

Table 2-1
Summary of Radionuclide Results in Surface Sediment Samples (0 to 2 feet)
Wolff-Alport Chemical Company Site

Radionuclide	Number of Detects/ Number of Samples	Minimum Concentration in Sediment (pCi/g)	Maximum Concentration in Sediment (pCi/g)	Average Concentration in Sediment[1] (pCi/g)
East Branch, Newtown Creek				
Radium-226	20/20	0.215	0.828	0.395
Thorium-228	24/24	0.311	11.922	1.195
Thorium- 230	24/24	0.193	1.574	0.406
Thorium-232	24/24	0.198	9.595	0.962
Uranium-234	24/24	0.169	0.952	0.41
Uranium-235	3/24	0.025	0.144	0.068
Uranium-238	24/24	0.136	0.961	0.373
Coney Island Creek				
Radium-226	10/10	0.298	0.539	0.398
Thorium-228	12/12	0.211	0.747	0.455
Thorium- 230	12/12	0.225	0.708	0.448
Thorium-232	12/12	0.23	0.612	0.396
Uranium-234	12/12	0.2	1.299	0.745
Uranium-235	2/12	0.117	0.165	0.141
Uranium-238	12/12	0.163	1.039	0.614

Note: pCi/g = picocuries per gram

Note:

[1]Average concentrations provide a more typical exposure and a general indication of spatial variability in the distribution of contamination

Table 2-2
Statistical Summary of Radionuclides in Sediment by Depth Interval
Wolff-Alport Chemical Company Site

Radionuclide	Start Depth (feet)	End Depth (feet)	Number of Detects/ Number of Samples	Minimum Detected Conc. (pCi/g)	Maximum Detected Conc. (pCi/g)	Average Detected Conc. (pCi/g)
East Branch Newtown Creek						
Radium-226	0	0.5	5/5	0.225	0.463	0.351
Thorium-228	0	0.5	8/8	0.337	0.925	0.644
Thorium-230	0	0.5	8/8	0.237	0.551	0.383
Thorium-232	0	0.5	8/8	0.278	1.079	0.618
Uranium-234	0	0.5	16/16	0.243	0.718	0.438
Uranium-235	0	0.5	1/8	0.025	0.025	0.025
Uranium-238	0	0.5	8/8	0.221	0.789	0.385
Radium-226	0.5	1	7/7	0.298	0.536	0.396
Thorium-228	0.5	1	8/8	0.311	1.270	0.704
Thorium-230	0.5	1	8/8	0.193	0.462	0.301
Thorium-232	0.5	1	8/8	0.248	1.150	0.533
Uranium-234	0.5	1	16/16	0.169	0.952	0.411
Uranium-235	0.5	1	1/8	0.036	0.036	0.036
Uranium-238	0.5	1	8/8	0.136	0.961	0.360
Radium-226	1	2	8/8	0.215	0.828	0.423
Thorium-228	1	2	8/8	0.384	11.922	2.238
Thorium-230	1	2	8/8	0.243	1.574	0.535
Thorium-232	1	2	8/8	0.198	9.595	1.736
Uranium-234	1	2	16/16	0.204	0.610	0.382
Uranium-235	1	2	1/8	0.144	0.144	0.144
Uranium-238	1	2	8/8	0.232	0.513	0.373
Radium-226	2	3	8/8	0.339	0.952	0.566
Thorium-228	2	3	9/9	0.520	17.139	4.539
Thorium-230	2	3	9/9	0.254	2.290	0.752
Thorium-232	2	3	9/9	0.128	15.060	3.676
Uranium-234	2	3	18/18	0.251	1.002	0.532
Uranium-235	2	3	5/9	0.035	0.078	0.056
Uranium-238	2	3	9/9	0.271	0.934	0.549
Radium-226	3	4	8/8	0.315	1.387	0.697
Thorium-228	3	4	9/9	0.407	21.311	4.436
Thorium-230	3	4	9/9	0.279	1.885	0.682
Thorium-232	3	4	8/9	0.396	15.923	3.932
Uranium-234	3	4	18/18	0.209	1.510	0.557
Uranium-235	3	4	3/9	0.027	0.105	0.061
Uranium-238	3	4	9/9	0.195	1.414	0.523
Radium-226	4	5	8/8	0.381	3.645	1.088
Thorium-228	4	5	8/8	0.747	57.968	10.583
Thorium-230	4	5	8/8	0.222	6.089	1.298
Thorium-232	4	5	8/8	0.292	42.704	7.558
Uranium-234	4	5	16/16	0.266	2.281	0.802
Uranium-235	4	5	4/8	0.031	0.088	0.054
Uranium-238	4	5	8/8	0.292	2.314	0.774
Radium-226	5	6	7/7	0.394	2.293	0.784
Thorium-228	5	6	7/7	0.627	77.485	12.198
Thorium-230	5	6	6/7	0.333	7.207	1.664
Thorium-232	5	6	7/7	0.386	56.355	8.932
Uranium-234	5	6	14/14	0.185	3.867	0.957
Uranium-235	5	6	2/7	0.044	0.215	0.130
Uranium-238	5	6	7/7	0.286	6.729	1.360

Table 2-2
Statistical Summary of Radionuclides in Sediment by Depth Interval
Wolff-Alport Chemical Company Site

Radionuclide	Start Depth (feet)	End Depth (feet)	Number of Detects/ Number of Samples	Minimum Detected Conc. (pCi/g)	Maximum Detected Conc. (pCi/g)	Average Detected Conc. (pCi/g)
East Branch Newtown Creek (continued)						
Radium-226	6	7	7/7	0.468	1.837	0.831
Thorium-228	6	7	8/8	0.618	27.437	4.099
Thorium-230	6	7	7/8	0.285	3.538	0.857
Thorium-232	6	7	8/8	0.353	24.693	3.637
Uranium-234	6	7	16/16	0.230	1.558	0.603
Uranium-235	6	7	3/8	0.024	0.064	0.040
Uranium-238	6	7	7/8	0.257	1.431	0.589
Radium-226	7	8	6/6	0.372	0.779	0.601
Thorium-228	7	8	7/7	0.716	1.721	1.096
Thorium-230	7	8	7/7	0.206	0.834	0.446
Thorium-232	7	8	7/7	0.211	1.465	0.834
Uranium-234	7	8	14/14	0.174	0.622	0.488
Uranium-235	7	8	1/7	0.036	0.036	0.036
Uranium-238	7	8	7/7	0.270	0.660	0.463
Radium-226	8	9	6/6	0.332	0.787	0.558
Thorium-228	8	9	7/7	0.616	1.428	1.017
Thorium-230	8	9	7/7	0.295	0.667	0.453
Thorium-232	8	9	7/7	0.506	1.013	0.782
Uranium-234	8	9	14/14	0.353	1.002	0.601
Uranium-235	8	9	3/7	0.012	0.042	0.024
Uranium-238	8	9	7/7	0.164	0.852	0.502
Radium-226	9	10	5/5	0.443	0.653	0.524
Thorium-228	9	10	6/6	0.553	1.871	0.965
Thorium-230	9	10	6/6	0.278	0.615	0.416
Thorium-232	9	10	6/6	0.499	1.276	0.759
Uranium-234	9	10	12/12	0.264	2.213	0.749
Uranium-235	9	10	1/6	0.035	0.035	0.035
Uranium-238	9	10	6/6	0.241	1.768	0.669
Coney Island Creek Reference Area						
Radium-226	0	0.5	7/7	0.324	0.539	0.413
Thorium-228	0	0.5	9/9	0.273	0.702	0.470
Thorium-230	0	0.5	9/9	0.266	0.708	0.492
Thorium-232	0	0.5	9/9	0.284	0.612	0.431
Uranium-234	0	0.5	18/18	0.200	1.299	0.697
Uranium-235	0	0.5	1/9	0.117	0.117	0.117
Uranium-238	0	0.5	9/9	0.160	1.008	0.525
Radium-226	0.5	1	2/2	0.298	0.316	0.307
Thorium-228	0.5	1	2/2	0.211	0.444	0.328
Thorium-230	0.5	1	2/2	0.225	0.338	0.282
Thorium-232	0.5	1	2/2	0.230	0.366	0.298
Uranium-234	0.5	1	4/4	0.799	0.842	0.821
Uranium-235	0.5	1	1/2	0.165	0.165	0.165
Uranium-238	0.5	1	2/2	0.705	0.895	0.800
Radium-226	1	2	1/1	0.476	0.476	0.476
Thorium-228	1	2	3/3	0.345	0.747	0.558
Thorium-230	1	2	3/3	0.334	0.475	0.409
Thorium-232	1	2	3/3	0.292	0.489	0.406
Uranium-234	1	2	6/6	0.312	0.922	0.639
Uranium-238	1	2	3/3	0.163	1.039	0.562

Table 2-2
Statistical Summary of Radionuclides in Sediment by Depth Interval
Wolff-Alport Chemical Company Site

Radionuclide	Start Depth (feet)	End Depth (feet)	Number of Detects/ Number of Samples	Minimum Detected Conc. (pCi/g)	Maximum Detected Conc. (pCi/g)	Average Detected Conc. (pCi/g)
Coney Island Creek Reference Area (continued)						
Radium-226	2	3	1/1	0.577	0.577	0.577
Thorium-228	2	3	2/2	0.414	0.549	0.482
Thorium-230	2	3	2/2	0.457	0.506	0.482
Thorium-232	2	3	2/2	0.263	0.309	0.286
Uranium-234	2	3	4/4	0.405	0.961	0.683
Uranium-238	2	3	2/2	0.297	0.680	0.489
Radium-226	3	4	2/2	0.427	0.532	0.480
Thorium-228	3	4	2/2	0.403	0.416	0.410
Thorium-230	3	4	2/2	0.355	0.469	0.412
Thorium-232	3	4	2/2	0.313	0.368	0.341
Uranium-234	3	4	4/4	0.555	0.680	0.618
Uranium-238	3	4	2/2	0.313	0.495	0.404
Thorium-228	4	5	2/2	0.322	0.521	0.422
Radium-226	4	5	2/2	0.285	0.400	0.343
Thorium-230	4	5	2/2	0.354	0.601	0.478
Thorium-232	4	5	2/2	0.354	0.416	0.385
Uranium-234	4	5	4/4	0.349	0.710	0.530
Uranium-238	4	5	2/2	0.353	0.511	0.432
Radium-226	5	6	1/1	0.417	0.417	0.417
Thorium-228	5	6	2/2	0.395	0.558	0.477
Thorium-230	5	6	2/2	0.385	0.459	0.422
Thorium-232	5	6	2/2	0.423	0.485	0.454
Uranium-234	5	6	4/4	0.523	0.795	0.659
Uranium-238	5	6	2/2	0.345	0.564	0.455
Radium-226	6	7	2/2	0.509	0.696	0.603
Thorium-228	6	7	2/2	0.378	0.584	0.481
Thorium-230	6	7	2/2	0.308	0.443	0.376
Thorium-232	6	7	2/2	0.434	0.468	0.451
Uranium-234	6	7	4/4	0.350	0.605	0.478
Uranium-238	6	7	2/2	0.251	0.371	0.311
Radium-226	7	8	2/2	0.347	0.595	0.471
Thorium-228	7	8	2/2	0.381	0.448	0.415
Thorium-230	7	8	2/2	0.354	0.527	0.441
Thorium-232	7	8	2/2	0.420	0.486	0.453
Uranium-234	7	8	4/4	0.316	0.399	0.358
Uranium-238	7	8	1/2	0.198	0.198	0.198
Radium-226	8	9	2/2	0.489	0.878	0.684
Thorium-228	8	9	2/2	0.539	0.625	0.582
Thorium-230	8	9	2/2	0.387	0.478	0.433
Thorium-232	8	9	2/2	0.580	0.645	0.613
Uranium-234	8	9	4/4	0.977	3.497	2.237
Uranium-238	8	9	2/2	0.591	1.061	0.826
Radium-226	9	10	2/2	0.383	0.669	0.526
Thorium-228	9	10	2/2	0.329	0.590	0.460
Thorium-230	9	10	2/2	0.328	0.561	0.445
Thorium-232	9	10	2/2	0.315	0.356	0.336
Uranium-234	9	10	4/4	0.374	0.529	0.452
Uranium-238	9	10	2/2	0.361	0.779	0.570

Notes:

pCi/g = picocuries per gram

Conc.= Concentration

Table 3-1
BCGs or No Further Action Levels for Radionuclides in Sediment
Wolff-Alport Chemical Company Site

Radionuclide	BCG or NFA (pCi/g)	Limiting Organism
Radium-226	101	Riparian Animal
Thorium-228	795	Riparian Animal
Thorium-230	10,400	Riparian Animal
Thorium-232	1,220	Riparian Animal
Uranium -234	5,270	Riparian Animal
Uranium-235	3,730	Riparian Animal
Uranium-238	2,490	Riparian Animal

Notes:

pCi/g = picocuries per gram

BCG = Biota Concentration Guide

NFA = No further Action Level

Table 4-1
Comparison of Sediment Results to Biota Concentration Guidelines
Wolff-Alport Chemical Company Site

Radionuclide	BCG (pCi/g)	Maximum Concentration in Sediment (pCi/g)	Ratio	Mean Concentration in Sediment (pCi/g)	Ratio
East Branch, Newtown Creek - Surface Sediment (0 to 2 feet)					
Radium-226	101	0.828	0.0082	0.395	0.0039
Thorium-228	795	11.922	0.0150	1.195	0.0015
Thorium-230	10,400	1.574	0.0002	0.406	0.00004
Thorium-232	1,220	9.595	0.0079	0.962	0.0008
Uranium-234	5,270	0.952	0.0002	0.410	0.0001
Uranium-235	3,730	0.144	0.00004	0.068	0.00002
Uranium-238	2,490	0.961	0.0004	0.373	0.0001
		Sum of Fractions	0.032		0.006
East Branch, Newtown Creek - Subsurface Sediment (Greater than 2 feet to 10 feet)					
Radium-226	101	3.645	0.036	0.748	0.0074
Thorium-228	795	77.485	0.097	5.064	0.0064
Thorium-230	10,400	7.207	0.001	0.826	0.0001
Thorium-232	1,220	56.355	0.046	3.910	0.0032
Uranium-234	5,270	3.867	0.001	0.674	0.0001
Uranium-235	3,730	0.215	0.0001	0.054	0.00001
Uranium-238	2,490	6.729	0.003	0.693	0.0003
		Sum of Fractions	0.184		0.017
Coney Island Creek - Surface Sediment (0 to 2 feet)					
Radium-226	101	0.539	0.0053	0.398	0.0039
Thorium-228	795	0.747	0.0009	0.455	0.0006
Thorium-230	10,400	0.708	0.0001	0.448	0.00004
Thorium-232	1,220	0.612	0.0005	0.396	0.0003
Uranium-234	5,270	1.299	0.0002	0.745	0.0001
Uranium-235	3,730	0.165	0.00004	0.141	0.00004
Uranium-238	2,490	1.039	0.0004	0.614	0.0002
		Sum of Fractions	0.008		0.005
Coney Island Creek - Subsurface Sediment (Greater than 2 feet to 10 feet)					
Radium-226	101	0.878	0.0087	0.510	0.0050
Thorium-228	795	0.625	0.0008	0.464	0.0006
Thorium-230	10,400	0.601	0.0001	0.429	0.00004
Thorium-232	1,220	0.645	0.0005	0.433	0.0004
Uranium-234	5,270	3.497	0.0007	0.761	0.0001
Uranium-235	3,730	ND	ND	ND	ND
Uranium-238	2,490	1.061	0.0004	0.476	0.0002
		Sum of Fractions	0.011		0.006

Notes:

pCi/g = picocuries per gram

BCG = Biota Concentration Guide

ND = not detected

Table 4-2
Summary of Screening of Radionuclides in Sediment by Depth Interval
Wolff-Alport Chemical Company Site

Radionuclide	Start Depth (feet)	End Depth (feet)	Maximum Detected Conc. (pCi/g)	Average Detected Conc. (pCi/g)	BCG (pCi/g)	Ratio of MAX Conc./BCG	Ratio of Avg.Conc./BCG
East Branch Newtown Creek							
Radium-226	0	0.5	0.463	0.3512	101	0.0046	0.0035
Thorium-228	0	0.5	0.925	0.644	795	0.0012	0.0008
Thorium-230	0	0.5	0.551	0.383	10400	0.0001	0.00004
Thorium-232	0	0.5	1.079	0.618	1220	0.0009	0.0005
Uranium-234	0	0.5	0.718	0.438	5270	0.0001	0.0001
Uranium-235	0	0.5	0.025	0.025	3730	0.00001	0.00001
Uranium-238	0	0.5	0.789	0.385	2497	0.0003	0.0002
Radium-226	0.5	1	0.536	0.396	101	0.0053	0.0039
Thorium-228	0.5	1	1.27	0.704	795	0.0016	0.0009
Thorium-230	0.5	1	0.462	0.301	10400	0.00004	0.00003
Thorium-232	0.5	1	1.15	0.533	1220	0.0009	0.0004
Uranium-234	0.5	1	0.952	0.411	5270	0.0002	0.0001
Uranium-235	0.5	1	0.036	0.036	3730	0.00001	0.00001
Uranium-238	0.5	1	0.961	0.360	2497	0.0004	0.0001
Radium-226	1	2	0.828	0.423	101	0.0082	0.0042
Thorium-228	1	2	11.922	2.238	795	0.0150	0.0028
Thorium-230	1	2	1.574	0.535	10400	0.0002	0.0001
Thorium-232	1	2	9.595	1.736	1220	0.0079	0.0014
Uranium-234	1	2	0.61	0.382	5270	0.0001	0.0001
Uranium-235	1	2	0.144	0.144	3730	0.00004	0.00004
Uranium-238	1	2	0.513	0.373	2497	0.0002	0.0001
Radium-226	2	3	0.952	0.566	101	0.0094	0.0056
Thorium-228	2	3	17.139	4.539	795	0.0216	0.0057
Thorium-230	2	3	2.29	0.752	10400	0.0002	0.0001
Thorium-232	2	3	15.06	3.676	1220	0.0123	0.0030
Uranium-234	2	3	1.002	0.532	5270	0.0002	0.0001
Uranium-235	2	3	0.078	0.056	3730	0.00002	0.00001
Uranium-238	2	3	0.934	0.549	2497	0.0004	0.0002
Radium-226	3	4	1.387	0.697	101	0.0137	0.0069
Thorium-228	3	4	21.311	4.436	795	0.0268	0.0056
Thorium-230	3	4	1.885	0.682	10400	0.0002	0.0001
Thorium-232	3	4	15.923	3.932	1220	0.0131	0.0032
Uranium-234	3	4	1.51	0.557	5270	0.0003	0.0001
Uranium-235	3	4	0.105	0.061	3730	0.00003	0.00002
Uranium-238	3	4	1.414	0.523	2497	0.0006	0.0002
Radium-226	4	5	3.645	1.088	101	0.0361	0.0108
Thorium-228	4	5	57.968	10.583	795	0.0729	0.0133
Thorium-230	4	5	6.089	1.298	10400	0.0006	0.0001
Thorium-232	4	5	42.704	7.558	1220	0.0350	0.0062
Uranium-234	4	5	2.281	0.802	5270	0.0004	0.0002
Uranium-235	4	5	0.088	0.054	3730	0.00002	0.00001
Uranium-238	4	5	2.314	0.774	2497	0.0009	0.0003
Radium-226	5	6	2.293	0.784	101	0.0227	0.0078
Thorium-228	5	6	77.485	12.198	795	0.0975	0.0153
Thorium-230	5	6	7.207	1.664	10400	0.0007	0.0002
Thorium-232	5	6	56.355	8.932	1220	0.0462	0.0073
Uranium-234	5	6	3.867	0.957	5270	0.0007	0.0002
Uranium-235	5	6	0.215	0.130	3730	0.0001	0.00003
Uranium-238	5	6	6.729	1.360	2497	0.0027	0.0005
Radium-226	6	7	1.837	0.831	101	0.0182	0.0082
Thorium-228	6	7	27.437	4.099	795	0.0345	0.0052
Thorium-230	6	7	3.538	0.857	10400	0.0003	0.0001
Thorium-232	6	7	24.693	3.637	1220	0.0202	0.0030
Uranium-234	6	7	1.558	0.603	5270	0.0003	0.0001
Uranium-235	6	7	0.064	0.040	3730	0.00002	0.00001
Uranium-238	6	7	1.431	0.589	2497	0.0006	0.0002
Radium-226	7	8	0.779	0.601	101	0.0077	0.0059
Thorium-228	7	8	1.721	1.096	795	0.0022	0.0014
Thorium-230	7	8	0.834	0.446	10400	0.0001	0.00004
Thorium-232	7	8	1.465	0.834	1220	0.0012	0.0007
Uranium-234	7	8	0.622	0.488	5270	0.0001	0.0001
Uranium-235	7	8	0.036	0.036	3730	0.00001	0.00001
Uranium-238	7	8	0.66	0.463	2497	0.0003	0.0002
Radium-226	8	9	0.787	0.558	101	0.0078	0.0055
Thorium-228	8	9	1.428	1.017	795	0.0018	0.0013
Thorium-230	8	9	0.667	0.453	10400	0.0001	0.00004
Thorium-232	8	9	1.013	0.782	1220	0.0008	0.0006
Uranium-234	8	9	1.002	0.601	5270	0.0002	0.0001
Uranium-235	8	9	0.042	0.024	3730	0.00001	0.00001
Uranium-238	8	9	0.852	0.502	2497	0.0003	0.0002
Radium-226	9	10	0.653	0.524	101	0.0065	0.0052
Thorium-228	9	10	1.871	0.965	795	0.0024	0.0012
Thorium-230	9	10	0.615	0.416	10400	0.0001	0.00004
Thorium-232	9	10	1.276	0.759	1220	0.0010	0.0006
Uranium-234	9	10	2.213	0.749	5270	0.0004	0.0001
Uranium-235	9	10	0.035	0.035	3730	0.00001	0.00001
Uranium-238	9	10	1.768	0.669	2497	0.0007	0.0003

Table 4-2
Summary of Screening of Radionuclides in Sediment by Depth Interval
Wolff-Alport Chemical Company Site

Radionuclide	Start Depth (feet)	End Depth (feet)	Maximum Detected Conc. (pCi/g)	Average Detected Conc. (pCi/g)	BCG (pCi/g)	Ratio of MAX Conc./BCG	Ratio of Avg.Conc./BCG
Coney Island Creek Reference Area							
Radium-226	0	0.5	0.539	0.413	101	0.0053	0.0041
Thorium-228	0	0.5	0.702	0.470	795	0.0009	0.0006
Thorium-230	0	0.5	0.708	0.492	10400	0.0001	0.00005
Thorium-232	0	0.5	0.612	0.431	1220	0.0005	0.0004
Uranium-234	0	0.5	1.299	0.697	5270	0.0002	0.0001
Uranium-235	0	0.5	0.117	0.117	3730	0.00003	0.00003
Uranium-238	0	0.5	1.008	0.525	2497	0.0004	0.0002
Radium-226	0.5	1	0.316	0.307	101	0.0031	0.0030
Thorium-228	0.5	1	0.444	0.328	795	0.0006	0.0004
Thorium-230	0.5	1	0.338	0.282	10400	0.0000	0.00003
Thorium-232	0.5	1	0.366	0.298	1220	0.0003	0.0002
Uranium-234	0.5	1	0.842	0.821	5270	0.0002	0.0002
Uranium-235	0.5	1	0.165	0.165	3730	0.00004	0.00004
Uranium-238	0.5	1	0.895	0.800	2497	0.0004	0.0003
Radium-226	1	2	0.476	0.476	101	0.0047	0.0047
Thorium-228	1	2	0.747	0.558	795	0.0009	0.0007
Thorium-230	1	2	0.475	0.409	10400	0.00005	0.00004
Thorium-232	1	2	0.489	0.406	1220	0.0004	0.0003
Uranium-234	1	2	0.922	0.639	5270	0.0002	0.0001
Uranium-238	1	2	1.039	0.562	2497	0.0004	0.0002
Radium-226	2	3	0.577	0.577	101	0.0057	0.0057
Thorium-228	2	3	0.549	0.482	795	0.0007	0.0006
Thorium-230	2	3	0.506	0.482	10400	0.00005	0.00005
Thorium-232	2	3	0.309	0.286	1220	0.0003	0.0002
Uranium-234	2	3	0.961	0.683	5270	0.0002	0.0001
Uranium-238	2	3	0.68	0.489	2497	0.0003	0.0002
Radium-226	3	4	0.532	0.480	101	0.0053	0.0047
Thorium-228	3	4	0.416	0.410	795	0.0005	0.0005
Thorium-230	3	4	0.469	0.412	10400	0.00005	0.00004
Thorium-232	3	4	0.368	0.341	1220	0.0003	0.0003
Uranium-234	3	4	0.68	0.618	5270	0.0001	0.0001
Uranium-238	3	4	0.495	0.404	2497	0.0002	0.0002
Thorium-228	4	5	0.521	0.422	795	0.0007	0.0005
Radium-226	4	5	0.4	0.343	101	0.0040	0.0034
Thorium-230	4	5	0.601	0.478	10400	0.0001	0.00005
Thorium-232	4	5	0.416	0.385	1220	0.0003	0.0003
Uranium-234	4	5	0.71	0.530	5270	0.0001	0.0001
Uranium-238	4	5	0.511	0.432	2497	0.0002	0.0002
Radium-226	5	6	0.417	0.417	101	0.0041	0.0041
Thorium-228	5	6	0.558	0.477	795	0.0007	0.0006
Thorium-230	5	6	0.459	0.422	10400	0.00004	0.00004
Thorium-232	5	6	0.485	0.454	1220	0.0004	0.0004
Uranium-234	5	6	0.795	0.659	5270	0.0002	0.0001
Uranium-238	5	6	0.564	0.455	2497	0.0002	0.0002
Radium-226	6	7	0.696	0.603	101	0.0069	0.0060
Thorium-228	6	7	0.584	0.481	795	0.0007	0.0006
Thorium-230	6	7	0.443	0.376	10400	0.00004	0.00004
Thorium-232	6	7	0.468	0.451	1220	0.0004	0.0004
Uranium-234	6	7	0.605	0.478	5270	0.0001	0.0001
Uranium-238	6	7	0.371	0.311	2497	0.0001	0.0001
Radium-226	7	8	0.595	0.471	101	0.0059	0.0047
Thorium-228	7	8	0.448	0.415	795	0.0006	0.0005
Thorium-230	7	8	0.527	0.441	10400	0.0001	0.00004
Thorium-232	7	8	0.486	0.453	1220	0.0004	0.0004
Uranium-234	7	8	0.399	0.358	5270	0.0001	0.0001
Uranium-238	7	8	0.198	0.198	2497	0.0001	0.0001
Radium-226	8	9	0.878	0.684	101	0.0087	0.0068
Thorium-228	8	9	0.625	0.582	795	0.0008	0.0007
Thorium-230	8	9	0.478	0.433	10400	0.00005	0.00004
Thorium-232	8	9	0.645	0.613	1220	0.0005	0.0005
Uranium-234	8	9	3.497	2.237	5270	0.0007	0.0004
Uranium-238	8	9	1.061	0.826	2497	0.0004	0.0003
Radium-226	9	10	0.669	0.526	101	0.0066	0.0052
Thorium-228	9	10	0.59	0.460	795	0.0007	0.0006
Thorium-230	9	10	0.561	0.445	10400	0.0001	0.00004
Thorium-232	9	10	0.356	0.336	1220	0.0003	0.0003
Uranium-234	9	10	0.529	0.452	5270	0.0001	0.0001
Uranium-238	9	10	0.779	0.570	2497	0.0003	0.0002

Notes:
pCi/g = picocuries per gram
Conc.= Concentration
BCG = Biota Concentration Guideline

Figures

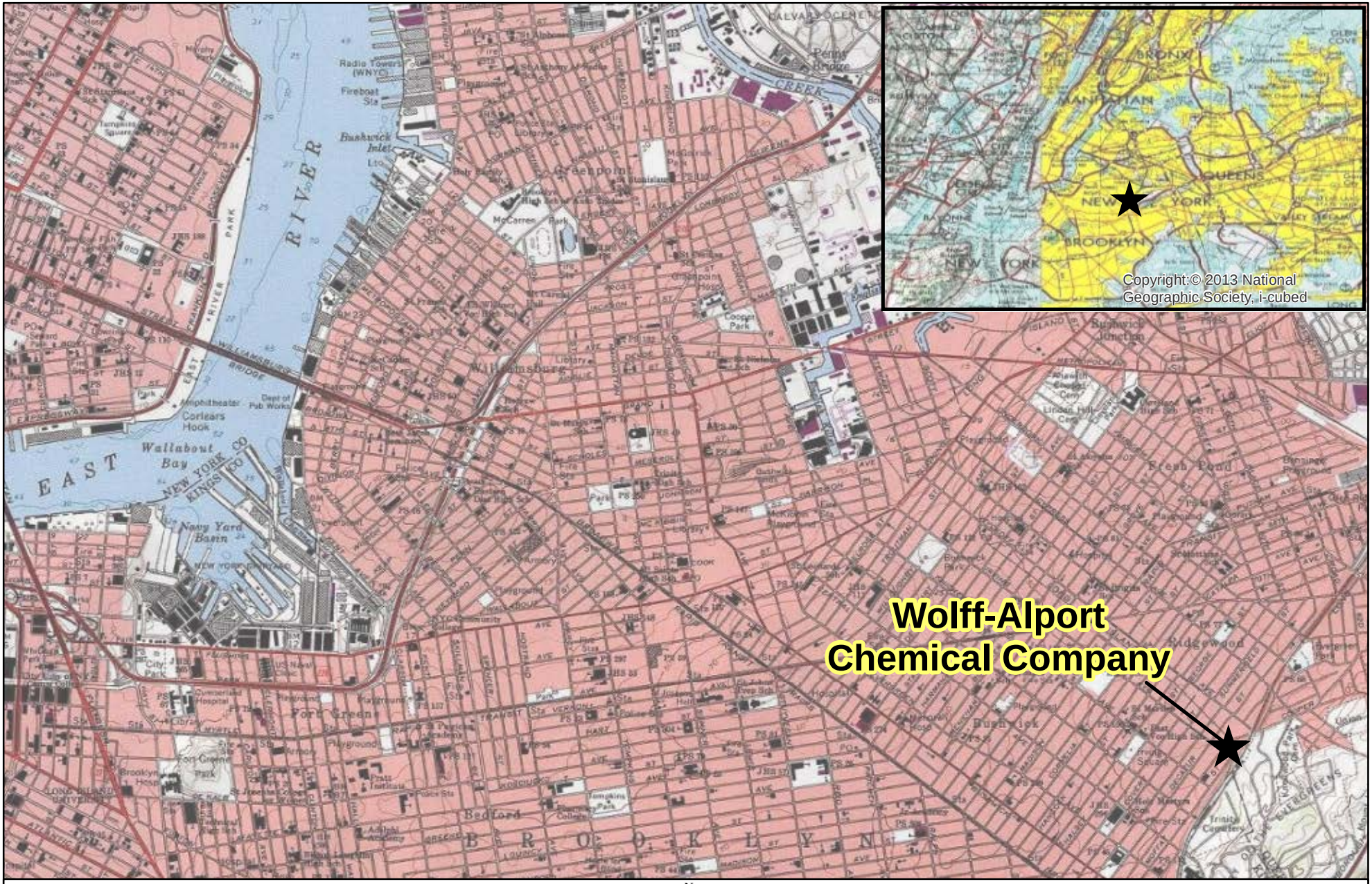
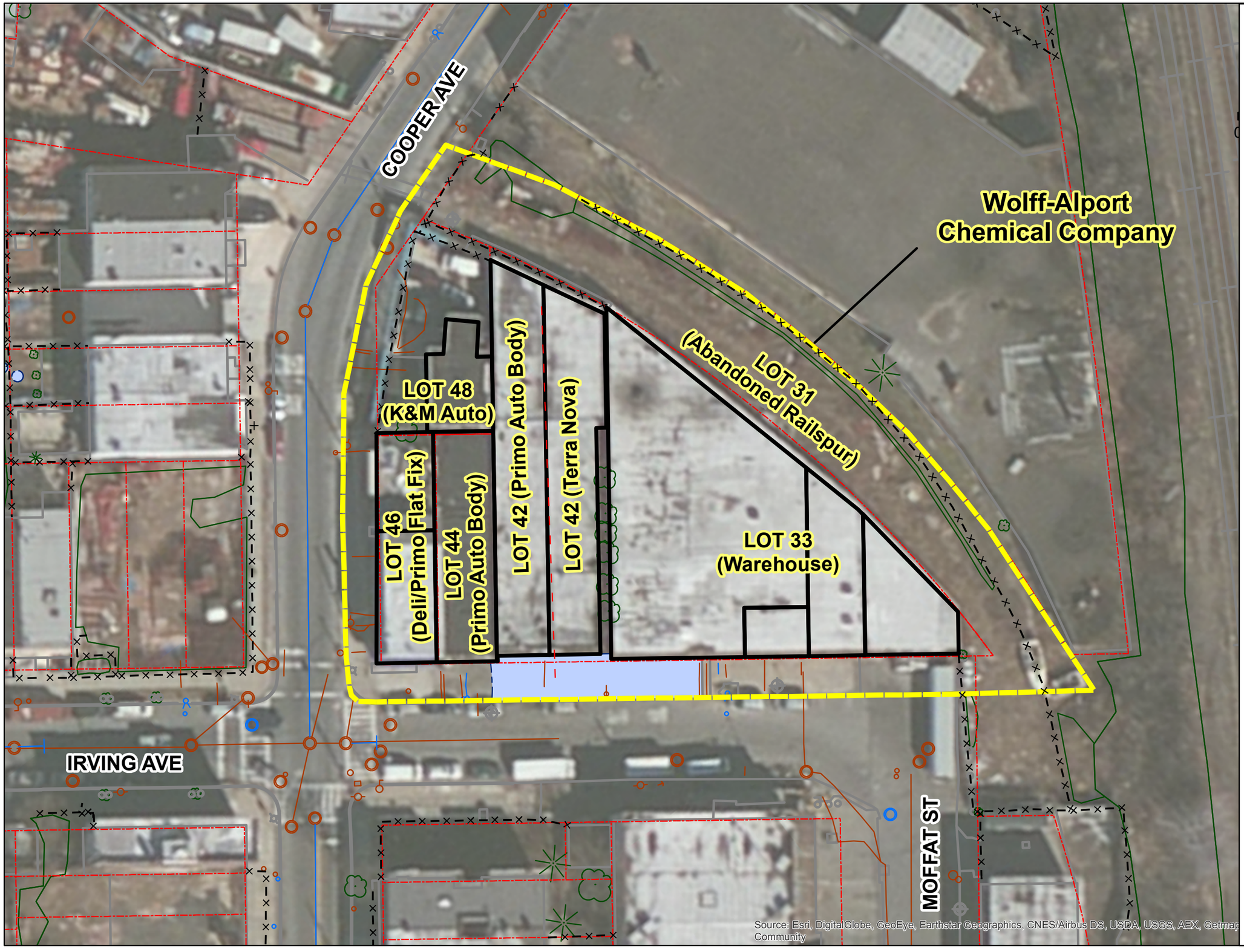


Figure 1-1
Site Location Map
Wolff-Alport Chemical Company Site
Ridgewood, Queens, New York

CDM Smith



Legend

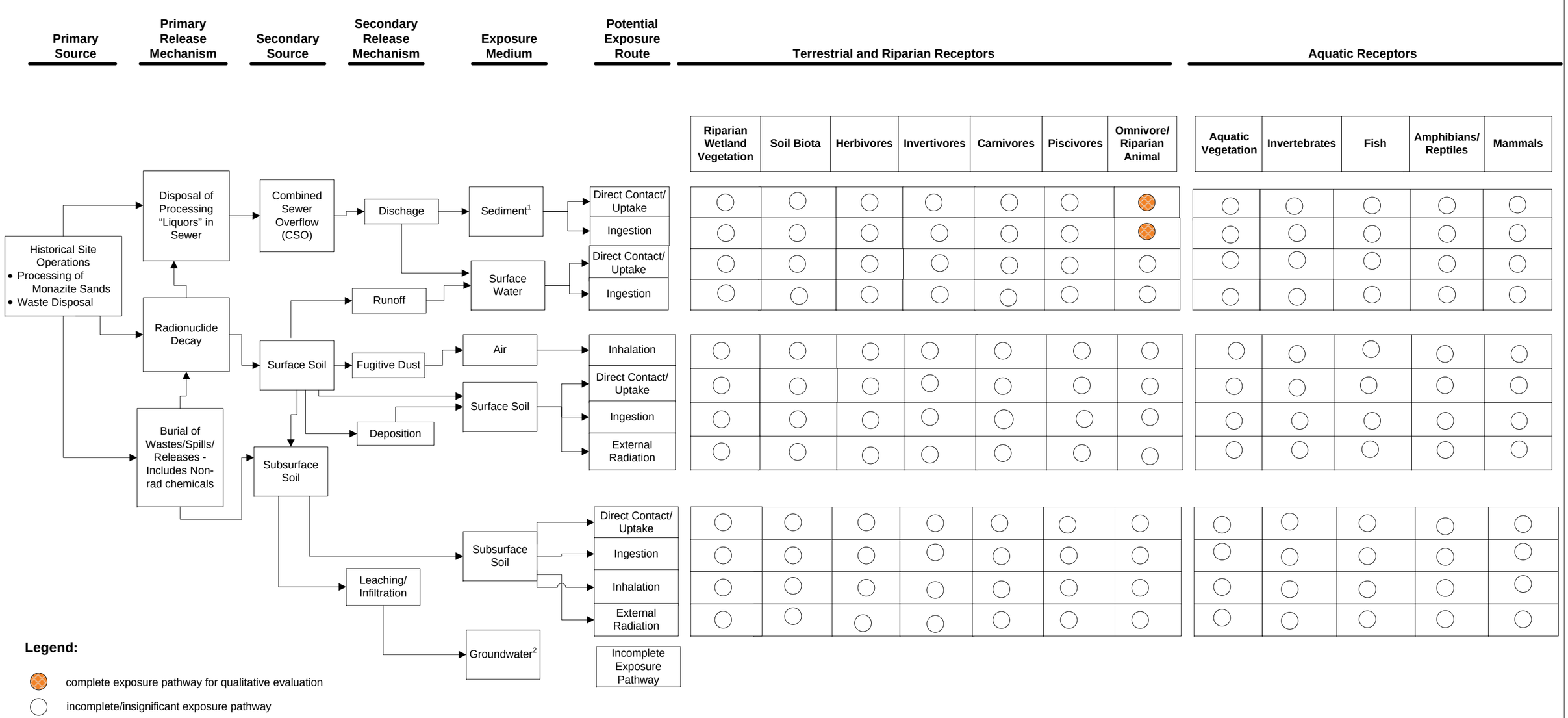
- Wolff-Alport Building and Interior Walls
- Property Lines
- Sewers
- Water Main
- Water Lines
- Building Outlines
- Edge of Vegetation
- Fenceline
- Lead Shielding (Exterior)

N E S W

0 20 40 80 Feet

Figure 1-2
Site Plan
Wolff-Alport Chemical Company Site
Ridgewood, Queens, New York

CDM Smith



[1] Contaminants in sediment may biomagnify in the food web. Radionuclide activities in food sources for riparian receptors are estimated in the RESRAD-Biota model from the sediment concentration.

[2] The groundwater exposure pathway is incomplete for ecological receptors.

Figure 2-1
Site Conceptual Exposure Model
Wolff-Alport Chemical Company Site
Ridgewood, Queens, New York

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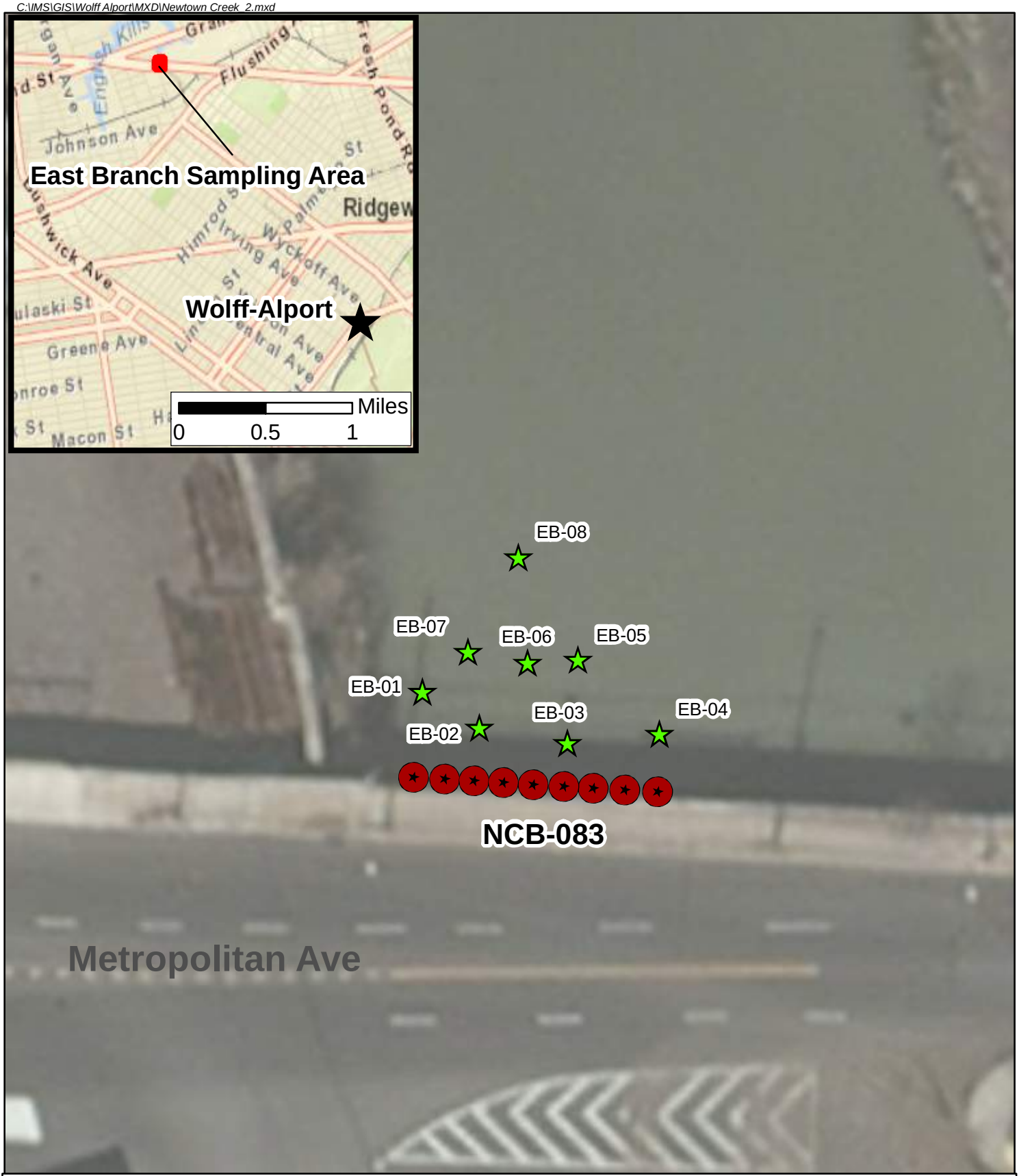

Sediment Core Location

Approximate Combined Sewer Overflow Discharge Location
(Morgan Avenue Interceptor East)

N
W
E
S

Feet
0 15 30 60

Figure 2-2
Sediment Sampling Locations
Newtown Creek - East Branch
Wolff-Alport Chemical Company Site
Ridgewood, Queens, New York

CDM Smith

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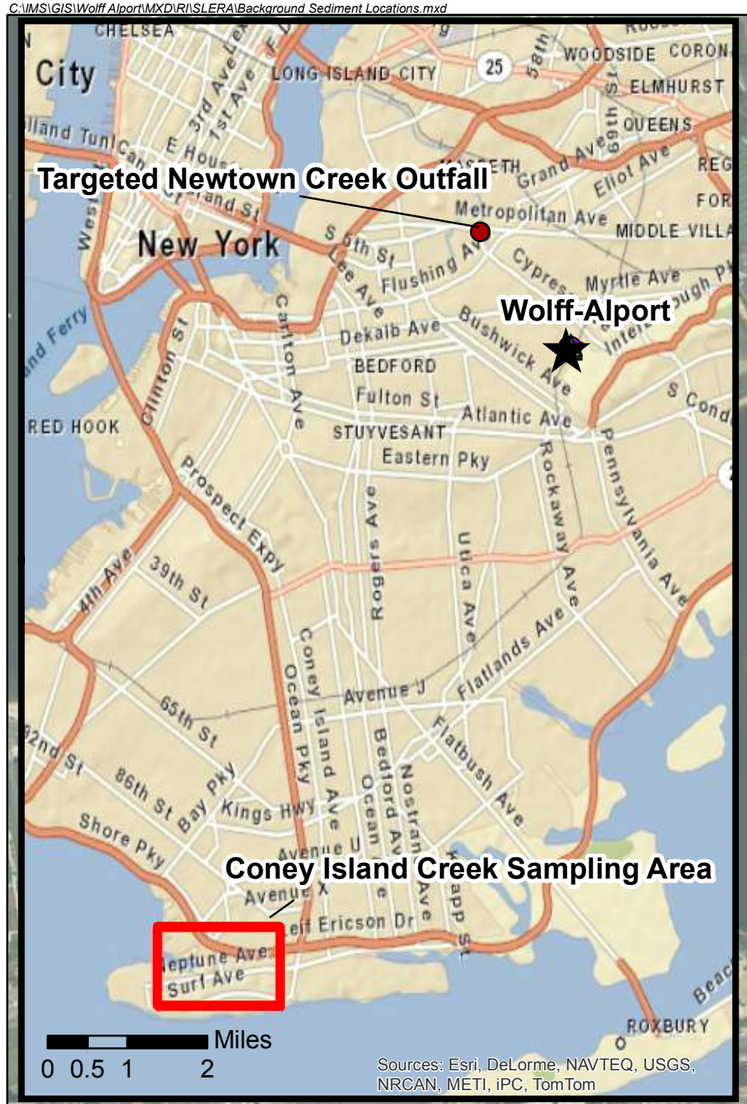

Legend

★ Proposed Background Sediment Core Location

N
W E
S

0 250 500 1,000 Feet

Figure 2-3
Background Sediment Sampling Locations
Coney Island Creek
Wolff-Alport Chemical Company Site
Ridgewood, Queens, New York

CDM Smith

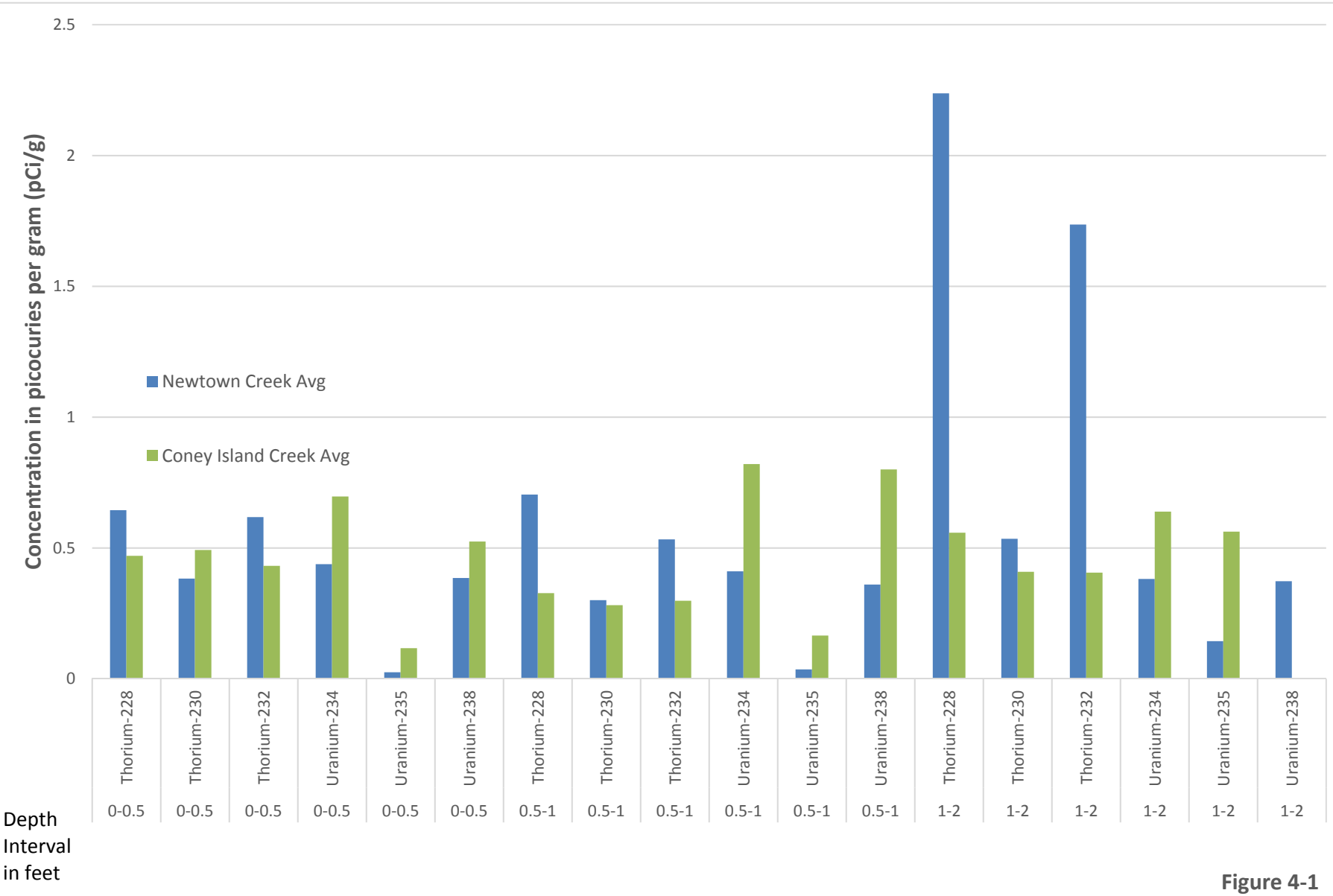

Figure 4-1
Average Isotropic Results for Surface Sediment
Wolff-Alport Chemical Company Site
Ridgewood, Queens, New York

Appendix A

Appendix A

Sediment Data

Appendix A
Table A-1
Sediment Isotopic Uranium and Thorium Analytical Results
Wolff-Alport Chemical Company Site

Location	Sample ID	Sample Date	Start Depth	End Depth	Depth Unit	Matrix	Sample Type	Parent Sample	Thorium-228				Thorium-230				Thorium-232				Uranium-234				Uranium-235				Uranium-238			
									Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q
Sediment East Branch																																
SED-EB01	SED-EB01-00-0.5	9/28/2015	0	0.5	ft	SE	N		0.896	0.25	0.04		0.439	0.186	0.186		1.079	0.287	0.174		0.537	0.105	0.043	J	0.04	0.02	0.04	U	0.461	0.097	0.057	
SED-EB01	SED-EB01-0.5-01	9/28/2015	0.5	1	ft	SE	N		0.401	0.126	0.046		0.212	0.091	0.071		0.297	0.107	0.068		0.952	0.172	0.052		0.056	0.031	0.056	U	0.961	0.175	0.071	
SED-EB01	SED-EB01-01-02	9/28/2015	1	2	ft	SE	N		1.173	0.317	0.112		0.477	0.195	0.149		1.252	0.33	0.166		0.321	0.088	0.057		0.056	0.034	0.056	U	0.334	0.092	0.067	
SED-EB01	SED-EB01-02-03	9/28/2015	2	3	ft	SE	N		17.139	2.245	0.078		2.29	0.418	0.088		15.06	1.988	0.097		0.764	0.174	0.076	J	0.041	0.036	0.022		0.854	0.187	0.082	
SED-EB01	SED-EB01-03-04	9/28/2015	3	4	ft	SE	N		21.311	2.921	0.123	J	1.885	0.461	0.277	J	15.923	2.217	0.189	J	1.51	0.252	0.069	J	0.105	0.059	0.068		1.414	0.243	0.095	
SED-EB01	SED-EB01-04-05	9/28/2015	4	5	ft	SE	N		57.968	7.897	0.406	J	6.089	1.324	0.401	J	42.704	5.914	0.446	J	2.281	0.337	0.049		0.088	0.047	0.047		2.314	0.342	0.068	
SED-EB01	SED-EB01-05-06	9/28/2015	5	6	ft	SE	N		77.485	12.212	0.938	J	7.207	2.433	1.391	J	56.355	9.191	1.034	J	3.867	0.526	0.035	J	0.215	0.067	0.03		6.729	0.873	0.042	
SED-EB01	SED-EB01-06-07	9/28/2015	6	7	ft	SE	N		27.437	3.642	0.098	J	3.538	0.68	0.131	J	24.693	3.293	0.139	J	1.558	0.231	0.025	J	0.064	0.032	0.026		1.431	0.216	0.041	
SED-EB01	SED-EB01-07-08	9/28/2015	7	8	ft	SE	N		1.721	0.32	0.047		0.526	0.148	0.065		1.465	0.283	0.068		0.483	0.097	0.031	J	0.035	0.027	0.035	U	0.389	0.086	0.048	
SED-EB01	SED-EB01-08-09	9/28/2015	8	9	ft	SE	N		1.033	0.242	0.049	J	0.458	0.148	0.067		0.86	0.214	0.071	J	0.353	0.078	0.033	J	0.018	0.016	0.01		0.351	0.078	0.028	
SED-EB01	SED-EB901-08-09	9/28/2015	8	9	ft	SE	FD	SED-EB01-08-09	0.765	0.206	0.031		0.542	0.169	0.081		0.7	0.196	0.092	J	0.377	0.085	0.037	J	0.012	0.013	0.011		0.393	0.088	0.043	
SED-EB01	SED-EB01-09-10	9/28/2015	9	10	ft	SE	N		0.553	0.172	0.032		0.278	0.129	0.129		0.499	0.167	0.114		0.264	0.068	0.038	J	0.035	0.027	0.034		0.241	0.066	0.048	J
SED-EB02	SED-EB02-00-0.5	9/28/2015	0	0.5	ft	SE	N		0.561	0.154	0.122	J	0.368	0.111	0.064		0.816	0.18	0.077		0.323	0.105	0.098	J	0.05	0.033	0.05	U	0.286	0.094	0.079	
SED-EB02	SED-EB02-0.5-01	9/28/2015	0.5	1	ft	SE	N		1.27	0.277	0.145	J	0.418	0.138	0.087	J	1.15	0.253	0.127		0.169	0.058	0.053		0.047	0.02	0.047	U	0.136	0.054	0.058	
SED-EB02	SED-EB02-01-02	9/28/2015	1	2	ft	SE	N		11.922	1.582	0.107	J	1.574	0.301	0.082		9.595	1.292	0.082		0.506	0.122	0.092		0.085	0.044	0.085	U	0.391	0.112	0.111	
SED-EB02	SED-EB02-02-03	9/28/2015	2	3	ft	SE	N		10.258	1.374	0.093	J	1.126	0.237	0.085		7.452	1.026	0.08		0.583	0.151	0.095	J	0.078	0.06	0.075		0.678	0.166	0.103	
SED-EB02	SED-EB02-03-04	9/28/2015	3	4	ft	SE	N		3.119	0.484	0.105	J	0.454	0.127	0.061		1.857	0.32	0.075	J	0.209	0.071	0.06	J	0.046	0.035	0.046	U	0.195	0.066	0.049	J
SED-EB02	SED-EB902-03-04	9/28/2015	3	4	ft	SE	FD	SED-EB02-03-04	1.891	0.334	0.079	J	0.55	0.144	0.045		1.298	0.251	0.052	J	0.637	0.15	0.09	J	0.071	0.04	0.071	U	0.588	0.152	0.13	J
SED-EB02	SED-EB02-04-05	9/28/2015	4	5	ft	SE	N		0.888	0.206	0.096	J	0.483	0.138	0.067		0.878	0.199	0.083		0.61	0.124	0.051	J	0.045	0.03	0.045	U	0.621	0.127	0.059	
SED-EB03	SED-EB03-00-0.5	9/29/2015	0	0.5	ft	SE	N		0.372	0.127	0.111	J	0.343	0.111	0.063		0.393	0.123	0.08	J	0.423	0.093	0.035		0.025	0.02	0.011		0.359	0.084	0.032	
SED-EB03	SED-EB03-0.5-01	9/29/2015	0.5	1	ft	SE	N		0.447	0.128	0.075	J	0.197	0.077	0.041		0.288	0.096	0.05	J	0.22	0.079	0.072		0.036	0.029	0.016		0.166	0.068	0.066	
SED-EB03	SED-EB03-01-02	9/29/2015	1	2	ft	SE	N		2.039	0.435	0.152	J	0.423	0.166	0.069	J	1.457	0.343	0.104	J	0.423	0.101	0.064		0.036	0.024	0.036	U	0.427	0.102	0.066	
SED-EB03	SED-EB03-02-03	9/29/2015	2	3	ft	SE	N		8.3	1.336	0.3	J	0.972	0.321	0.165	J	7.076	1.165	0.181	J	0.384	0.092	0.063		0.035	0.027	0.032		0.449	0.098	0.05	
SED-EB03	SED-EB03-03-04	9/29/2015	3	4	ft	SE	N		9.053	1.234	0.06	J	1.306	0.268	0.08		9.392	1.272	0.089	J	0.633	0.12	0.029		0.03	0.01	0.03	U	0.615	0.118	0.043	
SED-EB03	SED-EB03-04-05	9/29/2015	4	5	ft	SE	N		18.713	2.458	0.076	J	1.501	0.33	0.14		11.691	1.6	0.095	J	1.222	0.198	0.048		0.052	0.033	0.038		1.1	0.183	0.052	
SED-EB03	SED-EB03-05-06	9/29/2015	5	6	ft	SE	N		3.229	0.53	0.055	J	0.777	0.199	0.076		2.942	0.491	0.079	J	0.671	0.134	0.051		0.044	0.031	0.033		0.634	0.128	0.045	
SED-EB03	SED-EB03-06-07	9/29/2015	6	7	ft	SE	N		1.136	0.212	0.058	J	0.345	0.099	0.057		1.022	0.194	0.043	J	0.577	0.112	0.029		0.032	0.024	0.027		0.506	0.104	0.047	
SED-EB03	SED-EB03-07-08	9/29/2015	7	8	ft	SE	N		1.433	0.294	0.1	J	0.834	0.203	0.056		1.441	0.289	0.061	J	0.613	0.118	0.04		0.036	0.022	0.036	U	0.66	0.126	0.061	
SED-EB03	SED-EB03-08-09	9/29/2015	8	9	ft	SE	N		1.095	0.283	0.078		0.667	0.218	0.155		1.013	0.276	0.171		1.002	0.213	0.071	J	0.061	0.042	0.061	U	0.821	0.194	0.118	
SED-EB03	SED-EB03-09-10	9/29/2015	9	10	ft	SE	N		0.889	0.233	0.073		0.615	0.201	0.172		0.789	0.231	0.186		0.325	0.116	0.09		0.026	0.027	0.026	U	0.52	0.152	0.108	
SED-EB04	SED-EB04-00-0.5	9/29/2015	0	0.5	ft	SE	N		0.611	0.198	0.065		0.304	0.139	0.109		0.406	0.19	0.223		0.48	0.092	0.021	J	0.021	0.015	0.021	U	0.477	0.092	0.029	
SED-EB04	SED-EB04-0.5-01	9/29/2015	0.5	1	ft	SE	N		0.611	0.184	0.081		0.342	0.134	0.09		0.492	0.164	0.1		0.482	0.099	0.042	J	0.034	0.021	0.034	U	0.451	0.096	0.05	
SED-EB04	SED-EB04-01-02	9/29/2015	1	2	ft	SE	N		0.384	0.134	0.056		0.325	0.129	0.111		0.198	0.107	0.122		0.349	0.079	0.022	J	0.026	0.019	0.026	U	0.36	0.083	0.045	
SED-EB04	SED-EB04-02-03	9/29/2015	2	3	ft	SE	N		0.625	0.205	0.087		0.254	0.158	0.207		0.521	0.211	0.224		0.406	0.119	0.06		0.066	0.051	0.056		0.463	0.13	0.077	
SED-EB04	SED-EB904-02-03	9/29/2015	2	3	ft	SE	FD	SED-EB04-02-03	0.6	0.158	0.05		0.67	0.176	0.119	J	0.552	0.161	0.129	J	0.586	0.147	0.084		0.087	0.051	0.087	UJ	0.475	0.135	0.109	
SED-EB04	SED-EB04-03-04	9/29/2015	3	4	ft	SE	N		1.457	0.286	0.048	J	0.75	0.183	0.065		1.237	0.252	0.065		0.728	0.129	0.033	J	0.05	0.028	0.024		0.624	0.116	0.033	
SED-EB04	SED-EB04-04-05	9/29/2015	4	5	ft	SE	N		0.934	0.242	0.067		0.828	0.226	0.105		0.769	0.215	0.101		0.559	0.114	0.047	J	0.045	0.032	0.039		0.545	0.113	0.056	
SED-EB04	SED-EB04-05-06	9/29/2015	5	6	ft	SE	N		0.627	0.214	0.103		0.661	0.222	0.138		0.832	0.254	0.154	J	0.546	0.127	0.06		0.075	0.043	0.075	U	0.521	0.125	0.067	
SED-EB04	SED-EB04-06-07	9/29/2015	6	7	ft	SE	N		0.618	0.181	0.06		0.623	0.183	0.094		0.636	0.185	0.091	J	0.519	0.109	0.046		0.037	0.017	0.037	U	0.492	0.106	0.052	
SED-EB04	SED-EB04-07-08	9/29/2015	7	8	ft	SE	N		0.77	0.196	0.046		0.381	0.132	0.077		0.599	0.184	0.158	J	0.622	0.121	0.041		0.024	0.019	0.024	U	0.561	0.114	0.046	
SED-EB05	SED-EB05-00-0.5	9/28/2015	0	0.5	ft	SE	N		0.337	0.135	0.073		0.237	0.124	0.134	J	0.278	0.123	0.091	J	0.335	0.096	0.058		0.053	0.025	0.053	U	0.221	0.098	0.125	
SED-EB05	SED-EB05-0.5-01	9/28/2015	0.5	1	ft	SE	N		0.899	0.259	0.093		0.193	0.133	0.169		0.624	0.209	0.115		0.352	0.09	0.052		0.04	0.023	0.04	U	0.352	0.089	0.048	
SED-EB05	SED-EB05-01-02	9/28/2015	1	2	ft	SE	N		0.521	0.151	0.05		0.549	0.156	0.069		0.382	0.128	0.072	J	0.365	0.101	0.078		0.05	0.031	0.05	U	0.422	0.11	0.083	
SED-EB05	SED-EB05-02-03	9/28/2015	2	3	ft	SE	N		1.604	0.362	0.069		0.457	0.173	0.094		1.32	0.318	0.1	J	0.379	0.102	0.084		0.073	0.039	0.073	U	0.421	0.105	0.07	
SED-EB05	SED-EB05-03-04	9/28/2015	3	4	ft	SE	N		0.894	0.228	0.032		0.325	0.139	0.129		0.741	0.207	0.115	J	0.33	0.093	0.067		0.027	0.024	0.015		0.346	0.094	0.061	
SED-EB05	SED-EB05-04-05	9/28/2015	4	5	ft	SE	N		3.363	0.543	0.064	J	0.51	0.153	0.078		2.727	0.457	0.078		0.549	0.133	0.073	J	0.056	0.013	0.056	U	0.398	0.11	0.068	
SED-EB05	SED-EB05-05-06	9/28/2015	5	6	ft	SE	N		1.203	0.262	0.028	J	0.558	0.171	0.128		0.92	0.224	0.12		0.406	0.118	0.054	J	0.055	0.03	0.055	U	0.359	0.11	0.059	
SED-EB05	SED-EB05-06-07	9/28/2015	6	7	ft	SE	N		0.742	0.202	0.077	J	0.591	0.175	0.085		0.56	0.171	0.094		0.23	0.121	0.148	J	0.105	0.065	0.105	UJ	0.169	0.108	0.169	UJ
SED-EB05	SED-EB05-07-08	9/28/2015	7	8	ft	SE	N		0.716	0.185	0.044	J	0.462	0.143	0.073		0.629	0.168	0.054		0.174	0.123	0.167	J	0.083	0.067	0.083	UJ	0.27	0.142	0.162	J
SED-EB05	SED-EB05-08-09	9/28/2015	8	9	ft	SE	N		0.799	0.215	0.054	J	0.501	0.164	0.09		0.506	0.185	0.184		0.494	0.173	0.138	J	0.104	0.07	0.104	UJ	0.164	0.105	0.126	J
SED-EB05	SED-EB05-09-10	9/28/2015	9	10	ft	SE	N		0.604	0.157	0.044	J	0.426	0.127	0.067		0.513	0.141	0.064		0.796	0.369	0.335	J	0.109	0.112	0.109	UJ	0.605	0.321	0.314	J
SED-EB06	SED-EB06-00-0.5	9/29/2015	0	0.5	ft	SE	N		0.644	0.178	0.093	J	0.371	0.129	0.091		0.462	0.142	0.07		0.718	0.347	0.38	J	0.285	0.094	0.285	UJ	0.789	0.426	0.565	J
SED-EB06	SED-EB06-0.5-01	9/29/2015	0.5	1	ft	SE	N		0.664	0.185	0.122	J	0.462	0.142	0.075		0.475	0.143	0.069		0.552	0.127	0.069	J	0.059	0.033	0.059	U	0.371	0.104	0.085	
SED-EB06	SED-EB06-01-02	9/29/2015	1	2	ft	SE	N		0.421	0.128	0.067	J	0.264	0.096	0.05		0.308	0.103	0.035		0.61	0.198	0.175	J	0.144	0.103	0.127	J	0.513	0.192	0.204	J
SED-EB06	SED-EB06-02-03	9/29/2015	2	3	ft	SE	N		0.777	0.201	0.12	J	0.362	0.125	0.082		0.562	0.159	0.08		0.251	0.088	0.046	J	0.06	0.03	0.06	U	0.271	0.104	0.105	
SED-EB06	SED-EB06-03-04	9/29/2015	3	4	ft	SE	N		0.407	0.164	0.042		0.279	0.158	0.192		0.18	0.118	0.18	UJ	0.285	0.086	0.066	J	0.057	0.024	0.057	U	0.248	0.078	0.056	
SED-EB06	SED-EB06-04-05	9/29/2015	4	5	ft	SE	N		0.747	0.179	0.099		0.222	0.089	0.076	J	0.292	0.1	0.07	J	0.504	0.199	0.203	J	0.141	0.093	0.141	UJ	0.482	0.186	0.169	J
SED-EB06	SED-EB06-05-06	9/29/2015	5	6	ft	SE	N		1.043	0.364	0.152	J	0.376	0.232	0.376	UJ	0.388	0.232	0.256	J	0.69	0.167	0.064		0.075	0.043	0.075	U	0.624	0.162	0.099	
SED-EB06	SED-EB06-06-07	9/29/2015	6	7	ft	SE	N		0.706	0.375	0.306	J	0.333	0.211	0.333	UJ	0.64	0.364	0.37	J	0.597	0.147	0.063		0.024	0.027	0.022		0.489	0.132	0.074	
SED-EB06	SED-EB906-06-07	9/29/2015	6	7	ft	SE	FD	SED-EB06-06-07	0.673	0.21	0.084		0.29	0.158	0.193		0.353	0.175	0.209	J	0.614	0.116	0.036		0.038	0.026	0.038	U	0.625	0.118	0.044	
SED-EB06	SED-EB06-07-08	9/29/2015	7	8	ft	SE	N		0.743	0.267	0.1	J	0.206	0.145	0.163	J	0.211	0.137	0.121	J	0.534	0.144	0.053		0.07	0.05	0.07	U	0.568	0.148	0.044	
SED-EB06	SED-EB06-08-09	9/29/2015	8	9	ft	SE	N		1.381	0.534	0.219	J	0.405	0.303	0.356	J	0.921	0.55	0.729	J	0.656	0.119	0.023		0.042	0.025	0.01		0.57	0.108	0.031	
SED-EB06	SED-EB06-09-10	9/29/2015	9	10	ft	SE	N		0.944	0.246	0.069		0.293	0.136	0.133		0.713	0.213	0.147	J	0.527	0.107	0.04		0.034	0.022	0.034	U	0.548	0.109	0.031	
SED-EB07	SED-EB07-00-0.5	9/29/2015	0	0.5	ft	SE	N		0.925	0.208	0.059		0.551	0.151	0.066		0.761	0.184	0.073	J	0.243	0.077	0.056		0.059	0.029	0.059	U	0.257	0.083	0.07	

Appendix A
Table A-1
Sediment Isotopic Uranium and Thorium Analytical Results
Wolff-Alport Chemical Company Site

Location	Sample ID	Sample Date	Start Depth	End Depth	Depth Unit	Matrix	Sample Type	Parent Sample	Thorium-228				Thorium-230				Thorium-232				Uranium-234				Uranium-235				Uranium-238			
									Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q
SED-EB07	SED-EB07-0.5-01	9/29/2015	0.5	1	ft	SE	N		1.028	0.243	0.07		0.256	0.113	0.093		0.688	0.192	0.104		0.24	0.073	0.039		0.036	0.017	0.036	U	0.202	0.068	0.05	
SED-EB07	SED-EB07-01-02	9/29/2015	1	2	ft	SE	N		0.736	0.2	0.031		0.243	0.126	0.145	J	0.223	0.119	0.135	J	0.274	0.082	0.039		0.04	0.027	0.04	U	0.304	0.088	0.046	
SED-EB07	SED-EB07-02-03	9/29/2015	2	3	ft	SE	N		1.028	0.239	0.029		0.335	0.125	0.074		0.409	0.141	0.085	J	1.002	0.171	0.025		0.059	0.035	0.033		0.934	0.163	0.049	
SED-EB07	SED-EB07-03-04	9/29/2015	3	4	ft	SE	N		1.132	0.222	0.019		0.297	0.097	0.049		0.612	0.148	0.056	J	0.279	0.104	0.086		0.095	0.042	0.095	UJ	0.377	0.121	0.086	
SED-EB07	SED-EB07-04-05	9/29/2015	4	5	ft	SE	N		1.174	0.271	0.032		0.3	0.14	0.151	J	0.831	0.226	0.141	J	0.427	0.12	0.061		0.031	0.031	0.021		0.443	0.124	0.072	
SED-EB07	SED-EB07-05-06	9/29/2015	5	6	ft	SE	N		0.928	0.262	0.104		0.446	0.175	0.118		0.701	0.224	0.131	J	0.332	0.085	0.029		0.039	0.013	0.039	U	0.368	0.091	0.024	
SED-EB07	SED-EB07-06-07	9/29/2015	6	7	ft	SE	N		0.716	0.182	0.042		0.327	0.117	0.072		0.467	0.157	0.147	J	0.388	0.085	0.035		0.039	0.022	0.039	U	0.257	0.071	0.058	
SED-EB07	SED-EB07-07-08	9/29/2015	7	8	ft	SE	N		1.504	0.337	0.074		0.377	0.161	0.147		1.029	0.273	0.163	J	0.608	0.121	0.03		0.036	0.025	0.012		0.498	0.107	0.04	
SED-EB07	SED-EB07-08-09	9/29/2015	8	9	ft	SE	N		1.428	0.308	0.069		0.295	0.144	0.166	J	0.806	0.23	0.18	J	0.913	0.209	0.088	J	0.067	0.041	0.067	UJ	0.852	0.199	0.078	J
SED-EB07	SED-EB07-09-10	9/29/2015	9	10	ft	SE	N		1.871	0.357	0.056		0.508	0.158	0.087		1.276	0.274	0.084	J	2.213	0.374	0.108		0.081	0.062	0.081	UJ	1.768	0.318	0.121	
SED-EB08	SED-EB08-00-0.5	9/29/2015	0	0.5	ft	SE	N		0.809	0.192	0.04	J	0.449	0.135	0.067		0.748	0.193	0.137	J	0.447	0.119	0.08		0.055	0.037	0.055	U	0.232	0.086	0.084	
SED-EB08	SED-EB08-0.5-01	9/29/2015	0.5	1	ft	SE	N		0.311	0.107	0.055	J	0.324	0.108	0.061		0.248	0.095	0.068	J	0.317	0.082	0.044		0.049	0.025	0.049	U	0.243	0.071	0.049	
SED-EB08	SED-EB08-01-02	9/29/2015	1	2	ft	SE	N		0.704	0.19	0.056	J	0.427	0.148	0.111		0.472	0.158	0.123	J	0.204	0.071	0.058		0.051	0.024	0.051	U	0.232	0.084	0.087	
SED-EB08	SED-EB08-02-03	9/29/2015	2	3	ft	SE	N		0.52	0.136	0.042	J	0.303	0.108	0.1		0.128	0.081	0.109	J	0.429	0.107	0.061		0.039	0.032	0.039	U	0.394	0.104	0.074	
SED-EB08	SED-EB08-03-04	9/29/2015	3	4	ft	SE	N		0.662	0.165	0.043	J	0.293	0.104	0.067		0.396	0.122	0.064	J	0.401	0.112	0.069		0.057	0.027	0.057	U	0.303	0.102	0.093	
SED-EB08	SED-EB08-04-05	9/29/2015	4	5	ft	SE	N		0.879	0.2	0.054	J	0.449	0.133	0.072		0.569	0.154	0.08	J	0.266	0.071	0.032		0.03	0.022	0.03	U	0.292	0.076	0.037	
SED-EB08	SED-EB08-05-06	9/29/2015	5	6	ft	SE	N		0.873	0.201	0.051	J	0.333	0.119	0.093		0.386	0.123	0.063	J	0.185	0.089	0.066	J	0.086	0.037	0.086	UJ	0.286	0.124	0.126	J
SED-EB08	SED-EB08-06-07	9/29/2015	6	7	ft	SE	N		0.764	0.2	0.149	J	0.285	0.107	0.073		0.722	0.181	0.093	J	0.34	0.086	0.059		0.049	0.027	0.049	U	0.325	0.082	0.048	
SED-EB08	SED-EB08-07-08	9/29/2015	7	8	ft	SE	N		0.785	0.19	0.095	J	0.339	0.115	0.073		0.465	0.135	0.066	J	0.38	0.208	0.2	J	0.185	0.038	0.185	UJ	0.296	0.173	0.132	J
SED-EB08	SED-EB08-08-09	9/29/2015	8	9	ft	SE	N		0.616	0.152	0.057	J	0.301	0.099	0.057		0.67	0.157	0.05	J	0.409	0.085	0.039		0.033	0.022	0.033	U	0.365	0.081	0.054	
SED-EB08	SED-EB08-09-10	9/29/2015	9	10	ft	SE	N		0.929	0.201	0.077	J	0.377	0.116	0.071		0.761	0.174	0.067	J	0.371	0.093	0.06		0.044	0.033	0.044	U	0.334	0.089	0.065	
Sediment Coney Island Creek (Background)																																
SED-CIC01	SED-CIC01-00-0.5	10/9/2015	0	0.5	ft	SE	N		0.702	0.184	0.066		0.434	0.138	0.073		0.408	0.134	0.081		0.749	0.162	0.074		0.057	0.035	0.057	U	0.672	0.15	0.068	
SED-CIC01	SED-CIC01-0.5-01	10/9/2015	0.5	1	ft	SE	N		0.444	0.135	0.025		0.338	0.126	0.114		0.366	0.129	0.106		0.799	0.196	0.134		0.105	0.062	0.105	UJ	0.705	0.184	0.137	
SED-CIC01	SED-CIC01-01-02	10/9/2015	1	2	ft	SE	N		0.747	0.196	0.048		0.475	0.151	0.08		0.436	0.142	0.059		0.922	0.243	0.145	J	0.105	0.071	0.105	UJ	1.039	0.272	0.208	J
SED-CIC01	SED-CIC901-01-02	10/9/2015	1	2	ft	SE	FD	SED-CIC01-01-02	0.583	0.149	0.04		0.417	0.121	0.055		0.489	0.133	0.055		0.683	0.17	0.111	J	0.095	0.048	0.095	UJ	0.485	0.153	0.153	J
SED-CIC01	SED-CIC01-02-03	10/9/2015	2	3	ft	SE	N		0.549	0.168	0.051		0.506	0.161	0.085		0.263	0.139	0.174		0.961	0.292	0.188	J	0.17	0.106	0.17	UJ	0.68	0.313	0.406	J
SED-CIC01	SED-CIC01-03-04	10/9/2015	3	4	ft	SE	N		0.416	0.138	0.059		0.355	0.14	0.14		0.313	0.136	0.151		0.555	0.194	0.201	J	0.174	0.106	0.174	UJ	0.495	0.175	0.168	J
SED-CIC01	SED-CIC01-04-05	10/9/2015	4	5	ft	SE	N		0.521	0.154	0.052		0.601	0.167	0.079		0.416	0.135	0.077		0.71	0.203	0.147	J	0.133	0.059	0.133	UJ	0.511	0.188	0.201	J
SED-CIC01	SED-CIC01-05-06	10/9/2015	5	6	ft	SE	N		0.558	0.156	0.042		0.459	0.139	0.067		0.485	0.143	0.066		0.795	0.233	0.199	J	0.137	0.073	0.137	UJ	0.564	0.201	0.205	J
SED-CIC01	SED-CIC01-06-07	10/9/2015	6	7	ft	SE	N		0.584	0.154	0.053		0.443	0.131	0.069		0.434	0.13	0.077		0.605	0.185	0.125	J	0.087	0.053	0.087	UJ	0.371	0.167	0.2	J
SED-CIC01	SED-CIC01-07-08	10/9/2015	7	8	ft	SE	N		0.448	0.127	0.045		0.527	0.141	0.081		0.486	0.132	0.055		0.399	0.108	0.075		0.062	0.02	0.062	U	0.198	0.077	0.077	
SED-CIC01	SED-CIC01-08-09	10/9/2015	8	9	ft	SE	N		0.539	0.148	0.038		0.478	0.136	0.052		0.58	0.153	0.055		0.977	0.289	0.222	J	0.181	0.127	0.181	UJ	0.591	0.227	0.222	J
SED-CIC01	SED-CIC01-09-10	10/9/2015	9	10	ft	SE	N		0.59	0.151	0.021		0.561	0.149	0.085		0.315	0.108	0.076		0.529	0.172	0.146	J	0.098	0.069	0.098	UJ	0.779	0.215	0.171	J
SED-CIC02	SED-CIC02-00-0.5	10/21/2015	0	0.5	ft	SE	N		0.344	0.136	0.035		0.467	0.165	0.108		0.284	0.128	0.107	J	0.411	0.192	0.217	J	0.154	0.108	0.154	UJ	0.315	0.186	0.248	J
SED-CIC02	SED-CIC02-0.5-01	10/21/2015	0.5	1	ft	SE	N		0.211	0.096	0.029		0.225	0.104	0.089		0.23	0.101	0.069	J	0.842	0.315	0.284	J	0.165	0.135	0.141	J	0.895	0.321	0.274	J
SED-CIC02	SED-CIC02-01-02	10/21/2015	1	2	ft	SE	N		0.345	0.154	0.1		0.334	0.155	0.132		0.292	0.148	0.144	J	0.312	0.152	0.159	J	0.12	0.051	0.12	UJ	0.163	0.114	0.146	J
SED-CIC02	SED-CIC02-02-03	10/21/2015	2	3	ft	SE	N		0.414	0.144	0.06		0.457	0.158	0.119		0.309	0.125	0.092	J	0.405	0.161	0.136	J	0.133	0.097	0.133	UJ	0.297	0.188	0.27	J
SED-CIC02	SED-CIC02-03-04	10/21/2015	3	4	ft	SE	N		0.403	0.157	0.039		0.469	0.173	0.109		0.368	0.156	0.129	J	0.68	0.261	0.258	J	0.227	0.151	0.227	UJ	0.313	0.204	0.28	J
SED-CIC02	SED-CIC02-04-05	10/21/2015	4	5	ft	SE	N		0.322	0.128	0.032		0.354	0.134	0.073		0.354	0.134	0.073	J	0.349	0.155	0.191	J	0.177	0.076	0.177	UJ	0.353	0.171	0.23	J
SED-CIC02	SED-CIC02-05-06	10/21/2015	5	6	ft	SE	N		0.395	0.156	0.04		0.385	0.162	0.134		0.423	0.175	0.161	J	0.523	0.207	0.202	J	0.155	0.09	0.155	UJ	0.345	0.164	0.165	J
SED-CIC02	SED-CIC02-06-07	10/21/2015	6	7	ft	SE	N		0.378	0.164	0.047		0.308	0.146	0.075		0.468	0.186	0.118	J	0.35	0.209	0.272	J	0.14	0.029	0.14	UJ	0.251	0.166	0.21	J
SED-CIC02	SED-CIC02-07-08	10/21/2015	7	8	ft	SE	N		0.381	0.162	0.172		0.354	0.134	0.088		0.42	0.145	0.071	J	0.316	0.133	0.144	J	0.104	0.034	0.104	UJ	0.168	0.107	0.168	U
SED-CIC02	SED-CIC02-08-09	10/21/2015	8	9	ft	SE	N		0.625	0.175	0.096		0.387	0.128	0.063	J	0.645	0.172	0.063	J	3.497	0.67	0.282	J	0.196	0.106	0.196	UJ	1.061	0.323	0.234	J
SED-CIC02	SED-CIC02-09-10	10/21/2015	9	10	ft	SE	N		0.329	0.125	0.111		0.328	0.119	0.09		0.356	0.12	0.069	J	0.374	0.156	0.149	J	0.096	0.072	0.096	UJ	0.361	0.156	0.159	J
SED-CIC03	SED-CIC03-00-0.5	10/9/2015	0	0.5	ft	SE	N		0.653	0.168	0.093		0.708	0.171	0.07		0.612	0.155	0.063		0.955	0.261	0.175	J	0.127	0.042	0.127	UJ	0.672	0.231	0.229	J
SED-CIC04	SED-CIC04-00-0.5	10/9/2015	0	0.5	ft	SE	N		0.488	0.154	0.102		0.641	0.174	0.091		0.415	0.136	0.084		1.299	0.281	0.122	J	0.117	0.062	0.117	UJ	1.008	0.25	0.179	
SED-CIC05	SED-CIC05-00-0.5	10/9/2015	0	0.5	ft	SE	N		0.45	0.14	0.11		0.557	0.147	0.066		0.545	0.147	0.077		1.122	0.249	0.137	J	0.117	0.075	0.073	J	0.857	0.221	0.177	J
SED-CIC06	SED-CIC06-00-0.5	10/9/2015	0	0.5	ft	SE	N		0.308	0.105	0.071	J	0.541	0.139	0.053	J	0.396	0.116	0.057	J	0.2	0.076	0.053		0.04	0.026	0.04	U	0.228	0.085	0.07	
SED-CIC06	SED-CIC906-00-0.5	10/9/2015	0	0.5	ft	SE	FD	SED-CIC06-00-0.5	0.514	0.146	0.079	J	0.427	0.126	0.046		0.456	0.131	0.05		0.21	0.082	0.061		0.021	0.024	0.021	U	0.16	0.074	0.072	
SED-CIC07	SED-CIC07-00-0.5	10/9/2015	0	0.5	ft	SE	N		0.498	0.151	0.109		0.389	0.123	0.06		0.411	0.127	0.063		0.764	0.255	0.196	J	0.16	0.125	0.16	UJ	0.451	0.226	0.278	J
SED-CIC08	SED-CIC08-00-0.5	10/21/2015	0	0.5	ft	SE	N		0.273	0.117	0.114		0.266	0.103	0.061		0.356	0.122	0.07	J	0.56	0.195	0.121	J	0.112	0.077	0.112	UJ	0.359	0.162	0.154	J

Notes:
All units in picocuries per gram (pCi/g)
CSU (+/- s) = combined standard uncertainty (2 sigma)
FD = field duplicate
ft = feet
ID = identification
J = estimated value
MDA = minimum detectable activity
N = normal sample
Q = qualifier
SE = sediment
U = not detected
UJ = not detected, estimated value

Appendix A
Table A-2
Sediment Laboratory Analytical Results
Wolff-Alport Chemical Company Site

Location	Sample ID	Sample Date	Start Depth	End Depth	Depth Unit	Matrix	Sample Type	Parent Sample	Potassium-40				Radium-226				Thorium-232			
									Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q
Sediment East Branch																				
SED-EB01	SED-EB01-00-0.5	9/28/2015	0	0.5	ft	SE	N		3.443	1.696	2.2	R	0.367	0.208	0.367	R	0.566	0.328	0.566	R
SED-EB01	SED-EB01-0.5-01	9/28/2015	0.5	1	ft	SE	N		8.947	1.462	0.496		0.308	0.107	0.147		0.857	0.215	0.192	
SED-EB01	SED-EB01-01-02	9/28/2015	1	2	ft	SE	N		6.885	1.279	1.03		0.375	0.168	0.152		1.272	0.208	0.289	
SED-EB01	SED-EB01-02-03	9/28/2015	2	3	ft	SE	N		6.617	1.433	0.763		0.607	0.17	0.182		1.782	0.29	0.267	
SED-EB01	SED-EB01-03-04	9/28/2015	3	4	ft	SE	N		6.598	1.528	1.5		1.387	0.305	0.393		14.725	1.293	0.412	
SED-EB01	SED-EB01-04-05	9/28/2015	4	5	ft	SE	N		14.463	3.023	2.1	J	3.645	0.598	0.569	J	45.317	3.147	0.9	J
SED-EB01	SED-EB01-05-06	9/28/2015	5	6	ft	SE	N		19.436	3.159	2.11	J	2.293	0.664	0.798	J	70.211	4.781	0.967	J
SED-EB01	SED-EB01-06-07	9/28/2015	6	7	ft	SE	N		11.962	2.125	1.11		1.837	0.489	0.426		22.945	1.711	0.606	
SED-EB01	SED-EB01-07-08	9/28/2015	7	8	ft	SE	N		14.044	1.838	0.628		0.748	0.164	0.133		1.416	0.254	0.197	
SED-EB01	SED-EB01-08-09	9/28/2015	8	9	ft	SE	N		14.848	1.693	0.24		0.57	0.138	0.111		1.33	0.212	0.135	
SED-EB01	SED-EB901-08-09	9/28/2015	8	9	ft	SE	FD	SED-EB01-08-09	12.849	1.788	0.539		0.51	0.133	0.13		0.814	0.193	0.15	
SED-EB01	SED-EB01-09-10	9/28/2015	9	10	ft	SE	N		11.095	1.457	0.882		0.443	0.107	0.127		0.738	0.187	0.124	
SED-EB02	SED-EB02-00-0.5	9/28/2015	0	0.5	ft	SE	N		8.85	1.274	0.706		0.359	0.107	0.126		0.506	0.162	0.227	
SED-EB02	SED-EB02-0.5-01	9/28/2015	0.5	1	ft	SE	N		9.959	1.308	0.238		0.458	0.116	0.091		1.65	0.286	0.148	
SED-EB02	SED-EB02-01-02	9/28/2015	1	2	ft	SE	N		9.633	1.615	0.791		0.828	0.247	0.288		9.157	0.82	0.333	
SED-EB02	SED-EB02-02-03	9/28/2015	2	3	ft	SE	N		5.486	1.474	1.54	J	0.952	0.243	0.3	J	9.17	0.875	0.303	J
SED-EB02	SED-EB02-03-04	9/28/2015	3	4	ft	SE	N		12.365	1.556	0.264		0.874	0.209	0.181	J	5.037	0.534	0.119	J
SED-EB02	SED-EB902-03-04	9/28/2015	3	4	ft	SE	FD	SED-EB02-03-04	11.498	1.694	0.556		0.581	0.149	0.159	J	2.55	0.34	0.199	J
SED-EB02	SED-EB02-04-05	9/28/2015	4	5	ft	SE	N		13.241	1.69	0.785		0.667	0.149	0.134		0.983	0.218	0.207	
SED-EB03	SED-EB03-00-0.5	9/29/2015	0	0.5	ft	SE	N		9.362	1.383	0.794		0.225	0.094	0.137		0.721	0.16	0.147	
SED-EB03	SED-EB03-0.5-01	9/29/2015	0.5	1	ft	SE	N		12.111	1.488	0.243		0.466	0.114	0.076		0.856	0.153	0.107	
SED-EB03	SED-EB03-01-02	9/29/2015	1	2	ft	SE	N		7.575	1.538	1.17		0.346	0.142	0.199		2.254	0.345	0.283	
SED-EB03	SED-EB03-02-03	9/29/2015	2	3	ft	SE	N		10.157	1.548	0.478		0.793	0.218	0.248		8.868	0.746	0.253	
SED-EB03	SED-EB03-03-04	9/29/2015	3	4	ft	SE	N		6.943	1.238	0.348		0.862	0.275	0.277		7.877	0.798	0.261	
SED-EB03	SED-EB03-04-05	9/29/2015	4	5	ft	SE	N		11.022	1.776	1.15		1.858	0.433	0.336		16.022	1.296	0.403	
SED-EB03	SED-EB03-05-06	9/29/2015	5	6	ft	SE	N		10.328	1.682	0.634		0.761	0.197	0.234		5.013	0.563	0.225	
SED-EB03	SED-EB03-06-07	9/29/2015	6	7	ft	SE	N		11.665	1.754	0.756		0.787	0.163	0.144		1.165	0.218	0.214	
SED-EB03	SED-EB03-07-08	9/29/2015	7	8	ft	SE	N		14.014	1.867	0.527		0.619	0.147	0.167		1.184	0.222	0.146	
SED-EB03	SED-EB03-08-09	9/29/2015	8	9	ft	SE	N		19.044	2.195	0.859		0.787	0.159	0.133		1.292	0.199	0.147	
SED-EB03	SED-EB03-09-10	9/29/2015	9	10	ft	SE	N		15.228	1.962	0.524		0.596	0.142	0.154		0.817	0.169	0.18	
SED-EB04	SED-EB04-00-0.5	9/29/2015	0	0.5	ft	SE	N		2.789	1.461	2.31	R	0.296	0.164	0.255	R	0.526	0.257	0.458	R
SED-EB04	SED-EB04-0.5-01	9/29/2015	0.5	1	ft	SE	N		10.555	1.484	0.3		0.536	0.135	0.101		0.793	0.178	0.076	
SED-EB04	SED-EB04-01-02	9/29/2015	1	2	ft	SE	N		9.758	1.543	0.559		0.437	0.122	0.148		0.689	0.151	0.207	
SED-EB04	SED-EB04-02-03	9/29/2015	2	3	ft	SE	N		11.945	1.596	0.405		0.625	0.145	0.121		0.669	0.172	0.235	
SED-EB04	SED-EB904-02-03	9/29/2015	2	3	ft	SE	FD	SED-EB04-02-03	11.314	1.698	0.686		0.555	0.135	0.139		0.544	0.16	0.308	
SED-EB04	SED-EB04-03-04	9/29/2015	3	4	ft	SE	N		13.4	1.778	0.329		0.744	0.163	0.114		1.052	0.221	0.191	
SED-EB04	SED-EB04-04-05	9/29/2015	4	5	ft	SE	N		13.853	1.793	0.851		0.486	0.128	0.165		0.9	0.207	0.094	
SED-EB04	SED-EB04-05-06	9/29/2015	5	6	ft	SE	N		11.552	1.815	0.651		0.582	0.155	0.14		0.862	0.229	0.243	
SED-EB04	SED-EB04-06-07	9/29/2015	6	7	ft	SE	N		13.762	1.899	0.506		0.768	0.155	0.137		0.685	0.188	0.329	
SED-EB04	SED-EB04-07-08	9/29/2015	7	8	ft	SE	N		14.574	2.103	0.841		0.779	0.176	0.152		0.932	0.185	0.223	
SED-EB05	SED-EB05-00-0.5	9/28/2015	0	0.5	ft	SE	N		2.67	2.803	2.67	R	0.403	0.182	0.403	R	0.443	0.39	0.443	R
SED-EB05	SED-EB05-0.5-01	9/28/2015	0.5	1	ft	SE	N		5.914	1.45	0.588	R	0.534	0.204	0.202	R	0.75	0.261	0.468	R

Appendix A
Table A-2
Sediment Laboratory Analytical Results
Wolff-Alport Chemical Company Site

Location	Sample ID	Sample Date	Start Depth	End Depth	Depth Unit	Matrix	Sample Type	Parent Sample	Potassium-40				Radium-226				Thorium-232			
									Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q
SED-EB05	SED-EB05-01-02	9/28/2015	1	2	ft	SE	N		8.727	1.602	0.466	J	0.486	0.15	0.123	J	1.333	0.302	0.118	J
SED-EB05	SED-EB05-02-03	9/28/2015	2	3	ft	SE	N		8.519	1.662	1.32	J	0.339	0.145	0.197	J	0.901	0.262	0.37	J
SED-EB05	SED-EB05-03-04	9/28/2015	3	4	ft	SE	N		8.309	1.388	0.485		0.457	0.141	0.146		1.05	0.271	0.265	
SED-EB05	SED-EB05-04-05	9/28/2015	4	5	ft	SE	N		9.202	1.468	0.941		0.751	0.173	0.142		3.586	0.443	0.15	
SED-EB05	SED-EB05-05-06	9/28/2015	5	6	ft	SE	N		9.159	1.636	0.847		0.541	0.154	0.183		1.87	0.273	0.175	
SED-EB05	SED-EB05-06-07	9/28/2015	6	7	ft	SE	N		10.328	1.52	0.329		0.9	0.165	0.09		1.005	0.191	0.146	
SED-EB05	SED-EB05-07-08	9/28/2015	7	8	ft	SE	N		8.995	1.505	1.01		0.688	0.153	0.13		0.646	0.179	0.279	
SED-EB05	SED-EB05-08-09	9/28/2015	8	9	ft	SE	N		7.439	1.613	0.869	J	0.721	0.179	0.177	J	1.076	0.221	0.238	J
SED-EB05	SED-EB05-09-10	9/28/2015	9	10	ft	SE	N		6.031	1.317	0.875		0.653	0.17	0.189		0.982	0.211	0.217	
SED-EB06	SED-EB06-00-0.5	9/29/2015	0	0.5	ft	SE	N		5.468	1.262	0.479	J	0.463	0.151	0.109	J	0.692	0.219	0.283	J
SED-EB06	SED-EB06-0.5-01	9/29/2015	0.5	1	ft	SE	N		7.144	1.438	1		0.379	0.135	0.191		0.805	0.198	0.204	
SED-EB06	SED-EB06-01-02	9/29/2015	1	2	ft	SE	N		8.644	1.261	0.712		0.338	0.102	0.127		0.833	0.203	0.141	
SED-EB06	SED-EB06-02-03	9/29/2015	2	3	ft	SE	N		7.618	1.331	0.549		0.371	0.116	0.148		0.696	0.169	0.152	
SED-EB06	SED-EB06-03-04	9/29/2015	3	4	ft	SE	N		6.218	1.297	0.866		0.443	0.141	0.181		0.897	0.2	0.214	
SED-EB06	SED-EB06-04-05	9/29/2015	4	5	ft	SE	N		9.418	1.326	0.269		0.469	0.125	0.114		1.129	0.204	0.068	
SED-EB06	SED-EB06-05-06	9/29/2015	5	6	ft	SE	N		9.244	1.903	0.957	J	0.447	0.174	0.263	J	1.143	0.26	0.265	J
SED-EB06	SED-EB06-06-07	9/29/2015	6	7	ft	SE	N		8.171	1.554	1.21	J	0.474	0.156	0.176	J	0.743	0.214	0.334	J
SED-EB06	SED-EB906-06-07	9/29/2015	6	7	ft	SE	FD	SED-EB06-06-07	7.661	1.608	1.06	J	0.445	0.151	0.172	J	0.838	0.251	0.36	J
SED-EB06	SED-EB06-07-08	9/29/2015	7	8	ft	SE	N		9.28	1.762	0.534	R	0.482	0.222	0.218	R	1.163	0.406	0.374	R
SED-EB06	SED-EB06-08-09	9/29/2015	8	9	ft	SE	N		6.186	1.46	1.5	J	0.532	0.168	0.204	J	1.439	0.301	0.229	J
SED-EB06	SED-EB06-09-10	9/29/2015	9	10	ft	SE	N		6.072	1.334	0.936		0.456	0.157	0.183		1.252	0.251	0.185	
SED-EB07	SED-EB07-00-0.5	9/29/2015	0	0.5	ft	SE	N		8.536	1.404	0.924		0.385	0.119	0.148		1.295	0.236	0.102	
SED-EB07	SED-EB07-0.5-01	9/29/2015	0.5	1	ft	SE	N		8.559	1.194	0.239		0.324	0.116	0.118		1.505	0.249	0.162	
SED-EB07	SED-EB07-01-02	9/29/2015	1	2	ft	SE	N		8.718	1.463	0.573		0.215	0.101	0.158		1.025	0.257	0.219	
SED-EB07	SED-EB07-02-03	9/29/2015	2	3	ft	SE	N		8.361	1.363	0.461		0.386	0.122	0.132		1.094	0.212	0.203	
SED-EB07	SED-EB07-03-04	9/29/2015	3	4	ft	SE	N		11.351	1.444	0.25		0.495	0.133	0.132		1.589	0.21	0.063	
SED-EB07	SED-EB07-04-05	9/29/2015	4	5	ft	SE	N		8.988	1.448	0.928		0.446	0.128	0.14		1.251	0.203	0.103	
SED-EB07	SED-EB07-05-06	9/29/2015	5	6	ft	SE	N		7.079	1.556	0.842	J	0.47	0.164	0.207	J	0.835	0.225	0.362	J
SED-EB07	SED-EB07-06-07	9/29/2015	6	7	ft	SE	N		5.568	1.363	1.07	J	0.583	0.17	0.188	J	1.185	0.237	0.3	J
SED-EB07	SED-EB07-07-08	9/29/2015	7	8	ft	SE	N		5.397	1.529	1.42	J	0.398	0.17	0.245	J	1.614	0.346	0.255	J
SED-EB07	SED-EB07-08-09	9/29/2015	8	9	ft	SE	N		5.216	1.346	0.882	J	0.403	0.182	0.262	J	1.906	0.386	0.342	J
SED-EB07	SED-EB07-09-10	9/29/2015	9	10	ft	SE	N		7.982	1.724	1.52	R	0.65	0.198	0.233	R	2.341	0.457	0.168	R
SED-EB08	SED-EB08-00-0.5	9/29/2015	0	0.5	ft	SE	N		8.231	1.556	0.707		0.324	0.132	0.174		0.62	0.19	0.327	
SED-EB08	SED-EB08-0.5-01	9/29/2015	0.5	1	ft	SE	N		7.472	1.223	0.927		0.298	0.092	0.114		0.638	0.178	0.246	
SED-EB08	SED-EB08-01-02	9/29/2015	1	2	ft	SE	N		9.728	1.486	0.46		0.359	0.126	0.143		0.971	0.196	0.176	
SED-EB08	SED-EB08-02-03	9/29/2015	2	3	ft	SE	N		8.558	1.237	0.262		0.451	0.117	0.09		1.049	0.192	0.11	
SED-EB08	SED-EB08-03-04	9/29/2015	3	4	ft	SE	N		6.208	1.116	0.89		0.315	0.097	0.128		1.042	0.188	0.085	
SED-EB08	SED-EB08-04-05	9/29/2015	4	5	ft	SE	N		9.136	1.478	0.551		0.381	0.117	0.138		1.281	0.194	0.191	
SED-EB08	SED-EB08-05-06	9/29/2015	5	6	ft	SE	N		8.411	1.388	0.477		0.394	0.12	0.156		1.038	0.199	0.134	
SED-EB08	SED-EB08-06-07	9/29/2015	6	7	ft	SE	N		7.319	1.189	0.296		0.468	0.127	0.097		1.071	0.191	0.13	
SED-EB08	SED-EB08-07-08	9/29/2015	7	8	ft	SE	N		5.022	1.304	1.46	J	0.372	0.138	0.176	J	1.01	0.263	0.13	J
SED-EB08	SED-EB08-08-09	9/29/2015	8	9	ft	SE	N		7.302	1.385	0.633		0.332	0.118	0.179		1.132	0.221	0.175	
SED-EB08	SED-EB08-09-10	9/29/2015	9	10	ft	SE	N		7.412	1.327	0.507		0.472	0.134	0.133		0.875	0.21	0.192	

Appendix A
Table A-2
Sediment Laboratory Analytical Results
Wolff-Alport Chemical Company Site

Location	Sample ID	Sample Date	Start Depth	End Depth	Depth Unit	Matrix	Sample Type	Parent Sample	Potassium-40				Radium-226				Thorium-232			
									Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q	Result	CSU (+/-2 s)	MDA	Q
Sediment Coney Island Creek (Background)																				
SED-CIC01	SED-CIC01-00-0.5	10/9/2015	0	0.5	ft	SE	N		5.542	1.526	1.79	J	0.383	0.144	0.198	J	0.424	0.247	0.345	J
SED-CIC01	SED-CIC01-0.5-01	10/9/2015	0.5	1	ft	SE	N		6.677	1.636	0.996	J	0.316	0.156	0.224	J	0.472	0.307	0.472	UJ
SED-CIC01	SED-CIC01-01-02	10/9/2015	1	2	ft	SE	N		8.984	1.843	0.613	R	0.401	0.266	0.264	R	0.571	0.314	0.272	R
SED-CIC01	SED-CIC901-01-02	10/9/2015	1	2	ft	SE	FD	SED-CIC01-01-02	8.704	1.721	0.548	R	0.545	0.198	0.169	R	0.532	0.347	0.323	R
SED-CIC01	SED-CIC01-02-03	10/9/2015	2	3	ft	SE	N		8.773	2.012	1.14	R	0.32	0.184	0.189	R	0.391	0.385	0.391	R
SED-CIC01	SED-CIC01-03-04	10/9/2015	3	4	ft	SE	N		7.355	1.566	1.36	J	0.427	0.17	0.194	J	0.585	0.19	0.286	J
SED-CIC01	SED-CIC01-04-05	10/9/2015	4	5	ft	SE	N		6.221	1.647	1.09	J	0.285	0.16	0.245	J	0.56	0.197	0.302	J
SED-CIC01	SED-CIC01-05-06	10/9/2015	5	6	ft	SE	N		4.368	1.448	1.6	J	0.417	0.166	0.23	J	0.463	0.25	0.34	J
SED-CIC01	SED-CIC01-06-07	10/9/2015	6	7	ft	SE	N		7.481	1.509	0.492	J	0.509	0.165	0.131	J	0.689	0.19	0.124	J
SED-CIC01	SED-CIC01-07-08	10/9/2015	7	8	ft	SE	N		7.696	1.631	1.41	J	0.347	0.162	0.234	J	0.52	0.185	0.296	J
SED-CIC01	SED-CIC01-08-09	10/9/2015	8	9	ft	SE	N		10.164	2.016	0.971	J	0.489	0.18	0.23	J	0.434	0.258	0.434	UJ
SED-CIC01	SED-CIC01-09-10	10/9/2015	9	10	ft	SE	N		8.988	1.792	0.78	J	0.383	0.169	0.239	J	0.405	0.206	0.405	UJ
SED-CIC02	SED-CIC02-00-0.5	10/21/2015	0	0.5	ft	SE	N		9.613	1.638	1.12	J	0.539	0.153	0.16	J	0.531	0.172	0.217	J
SED-CIC02	SED-CIC02-0.5-01	10/21/2015	0.5	1	ft	SE	N		8.71	1.69	0.953		0.298	0.121	0.175		0.35	0.209	0.35	U
SED-CIC02	SED-CIC02-01-02	10/21/2015	1	2	ft	SE	N		9.877	1.625	0.556		0.476	0.156	0.173		0.53	0.182	0.299	
SED-CIC02	SED-CIC02-02-03	10/21/2015	2	3	ft	SE	N		8.784	1.54	0.423	J	0.577	0.182	0.159	J	0.834	0.185	0.107	J
SED-CIC02	SED-CIC02-03-04	10/21/2015	3	4	ft	SE	N		5.501	1.54	1.82	J	0.532	0.161	0.179	J	0.544	0.204	0.351	J
SED-CIC02	SED-CIC02-04-05	10/21/2015	4	5	ft	SE	N		4.44	1.603	1.82	J	0.4	0.186	0.281	J	0.524	0.331	0.524	UJ
SED-CIC02	SED-CIC02-05-06	10/21/2015	5	6	ft	SE	N		5.515	1.704	1.7	R	0.484	0.198	0.277	R	0.774	0.323	0.457	R
SED-CIC02	SED-CIC02-06-07	10/21/2015	6	7	ft	SE	N		8.703	1.65	1.27	J	0.696	0.172	0.138	J	0.926	0.218	0.141	J
SED-CIC02	SED-CIC02-07-08	10/21/2015	7	8	ft	SE	N		7.855	1.595	1.04		0.595	0.153	0.18		1.341	0.301	0.204	
SED-CIC02	SED-CIC02-08-09	10/21/2015	8	9	ft	SE	N		11.36	2.12	0.852	J	0.878	0.214	0.219	J	0.43	0.286	0.427	J
SED-CIC02	SED-CIC02-09-10	10/21/2015	9	10	ft	SE	N		10.965	1.767	0.434	J	0.669	0.237	0.189	J	0.948	0.196	0.176	J
SED-CIC03	SED-CIC03-00-0.5	10/9/2015	0	0.5	ft	SE	N		10.968	2.211	1.08	J	0.498	0.199	0.247	J	0.508	0.229	0.423	J
SED-CIC04	SED-CIC04-00-0.5	10/9/2015	0	0.5	ft	SE	N		7.534	1.758	1.09	J	0.445	0.192	0.274	J	0.561	0.249	0.395	J
SED-CIC05	SED-CIC05-00-0.5	10/9/2015	0	0.5	ft	SE	N		8.583	1.833	0.638	R	0.466	0.214	0.203	R	0.445	0.384	0.376	R
SED-CIC06	SED-CIC06-00-0.5	10/9/2015	0	0.5	ft	SE	N		10.518	1.429	0.73		0.333	0.093	0.115		0.306	0.123	0.184	
SED-CIC06	SED-CIC906-00-0.5	10/9/2015	0	0.5	ft	SE	FD	SED-CIC06-00-0.5	9.338	1.475	0.477		0.312	0.106	0.129		0.261	0.171	0.261	U
SED-CIC07	SED-CIC07-00-0.5	10/9/2015	0	0.5	ft	SE	N		7.308	1.784	1.43	J	0.324	0.156	0.234	J	0.469	0.303	0.469	UJ
SED-CIC08	SED-CIC08-00-0.5	10/21/2015	0	0.5	ft	SE	N		5.424	1.142	1.1		0.37	0.104	0.109		0.336	0.166	0.219	

Notes:
All units in picocuries per gram (pCi/g)
CSU (+/- s) = combined standard uncertainty (2 sigma)
FD = field duplicate
ft = feet
ID = identification
MDA = minimum detectable activity
N = normal sample
Q = qualifier J = estimated value R = rejected value U = not detected UJ = not detected, estimated value
SE = sediment

Appendix B

Appendix B

RESRAD-BIOTA Output

Aquatic BCG Report for Level 2

Title: Default

Sum of Total Ratio: 1.00E+00

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 1.00E+00

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Th-228	0	3.74E+02	0.00E+00	Yes	795	1.60E+04	4.96E-02	No
Summed	-	-	0.00E+00	-	-	-	4.96E-02	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Th-228	0	2.04E+03	0.00E+00	No	795	7.95E+02	1.00E+00	Yes
Summed	-	-	0.00E+00	-	-	-	1.00E+00	-

Aquatic BCG Report for Level 2

Title: WACC BCG

Sum of Total Ratio: 9.97E-01

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 9.97E-01

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Th-230	0	2.57E+03	0.00E+00	Yes	10400	2.74E+06	3.79E-03	No
Summed	-	-	0.00E+00	-	-	-	3.79E-03	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Th-230	0	1.39E+04	0.00E+00	No	10400	1.04E+04	9.97E-01	Yes
Summed	-	-	0.00E+00	-	-	-	9.97E-01	-

Aquatic BCG Report for Level 2

Title: Default

Sum of Total Ratio: 9.98E-01

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 9.98E-01

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Th-232	0	3.07E+02	0.00E+00	Yes	1220	3.29E+06	3.71E-04	No
Summed	-	-	0.00E+00	-	-	-	3.71E-04	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Th-232	0	1.69E+03	0.00E+00	No	1220	1.22E+03	9.98E-01	Yes
Summed	-	-	0.00E+00	-	-	-	9.98E-01	-

Aquatic BCG Report for Level 2

Title: WACC BCG

Sum of Total Ratio: 9.99E-01

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 9.99E-01

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
U-234	0	2.02E+02	0.00E+00	Yes	5270	3.08E+06	1.71E-03	No
Summed	-	-	0.00E+00	-	-	-	1.71E-03	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
U-234	0	6.84E+02	0.00E+00	No	5270	5.27E+03	9.99E-01	Yes
Summed	-	-	0.00E+00	-	-	-	9.99E-01	-

Aquatic BCG Report for Level 2

Title: WACC BCG

Sum of Total Ratio: 1.00E+00

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 1.00E+00

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
U-235	0	2.18E+02	0.00E+00	Yes	3730	1.05E+05	3.56E-02	No
Summed	-	-	0.00E+00	-	-	-	3.56E-02	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
U-235	0	7.37E+02	0.00E+00	No	3730	3.73E+03	1.00E+00	Yes
Summed	-	-	0.00E+00	-	-	-	1.00E+00	-

Aquatic BCG Report for Level 2

Title: WACC BCG

Sum of Total Ratio: 1.00E+00

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 1.00E+00

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
U-238	0	2.24E+02	0.00E+00	Yes	2500	4.29E+04	5.83E-02	No
Summed	-	-	0.00E+00	-	-	-	5.83E-02	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
U-238	0	7.57E+02	0.00E+00	No	2500	2.49E+03	1.00E+00	Yes
Summed	-	-	0.00E+00	-	-	-	1.00E+00	-

Aquatic BCG Report for Level 2

Title: Default

Sum of Total Ratio: 9.98E-01

Sum of Water Ratio: 0.00E+00

Sum of Sediment Ratio: 9.98E-01

	Aquatic Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Ra-226	0	1.02E+00	0.00E+00	Yes	101	1.45E+03	6.97E-02	No
Summed	-	-	0.00E+00	-	-	-	6.97E-02	-

	Riparian Animal							
	Water				Sediment			
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Limiting Organism	Concentration (pCi/g)	BCG (pCi/g)	Ratio	Limiting Organism
Ra-226	0	4.08E+00	0.00E+00	No	101	1.01E+02	9.98E-01	Yes
Summed	-	-	0.00E+00	-	-	-	9.98E-01	-